SOME ASPECTS OF

THE FLORA OF BARBADOS

BY

F. HARDY, M.A., DIP., AGRIC.

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BARBADOS.

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FOREWORD

Barbados is fortunate in the wealth of its literature. Poyer, Ligon and Schomburgk have dealt with general descriptions of the island and its physical and vegetative resources.

Professor Hardy in his "Flora of Barbados" has confined himself, although very comprehensively, with the botanical aspect; and although it is seventeen years since the work was finished, there is no doubt that his book will remain an authoritative compilation for a great many years yet.

Professor Hardy wishes to thank Mr. W. A. McD. Paterson for compiling the index.

R. W. R. MILLER,
Director of Agriculture.

15.6.34.

(see Bibliography), should form an excellent ground-work for further detailed study.

Part II deals exclusively with the vegetation of Barbados. Here an attempt is made to illustrate the relation between the plants of the Island and the environments in which they are found. The vegetation of certain districts in Barbados is described in some detail, and here the names of the more typical plants occupying those districts are given with a simple description of many of the species mentioned. It is with the naming of the plants of Barbados that considerable difficulty has been experienced. Had it not been for the existence of the excellently-preserved and carefully named dried plant specimens belonging to the Barbados Department of Agriculture, and for the great assistance so freely rendered me by Mr. J. S. Dash, B.S.A. (Assistant Superintendent of the Department), it would have been quite impossible for me to have acquired in the time at my disposal that familiarity with the flora of the Island which was essential to a correct compilation of plant lists made during my surveys. I wish here, therefore to record my appreciation of the courtesy of Mr. J. R. Bovell, I.S.O. (Superintendent of the Barbados Department of Agriculture) in so kindly placing his herbarium at my disposal, and also to record my gratitude to Mr. Bovell and to Mr. Dash for their willing assistance. The material of the herbarium was collected in the years 1905—1906 (chiefly by Mr. Dash himself) and duplicates were sent to the New York Botanical Gardens, where Dr. N. L. Britton, the Director, determined the names of the plants, and forwarded his lists to Barbados. The plant-names have since been frequently revised and the herbarium extended. Recently (1917) Mr. Dash has built up a card index into which the accepted name of each plant according to "Index Kewensis" has been entered. But the greatest difficulty of all has been experienced in connexion with the vernacular or common names of the plants. There are so many different names for certain of the plants of Barbados (especially of wild plants), and the same common name is so often used for more than one botanically distinct plant, that the assignation of easily-remembered titles to the majority of the Barbados plants has proved to be a task yielding very unsatisfactory results. In most cases of doubt one or other of the vernacular names given in the plant list in Schomburgk's "History of Barbados" (1848) has been adopted. It will be noticed that after the name of each plant the botanical family of the species is indicated. Plants are classified in the main according to the structure of their flowers. An account of this method of classification will be found in the invaluable "Dictionary of Flowering Plants and Ferns" by J. C. Willis (Bibliography No. 3). By a use of this book the characteristics of the various families of plants alluded to in the following pages may be learned. It is to be noticed that the system of classification employed in Willis' book and also in these notes, is that due to Engler (1903). This system is in many ways more satisfactory and more up-to-date than that of Bentham and Hooker (1862—1893). The plant descriptions in this volume have, as far as possible, been kept free of abstruse botanical terms. Any expressions not in every day use that have been employed, may be found in an ordinary English dictionary. Further information of a more technical kind

may be obtained from Grisebach's "Flora of the British West Indies" (1864), (Bibliography No. 20) by tracing in the index the name of the plant about which more information is required, and then referring to its description in the letter press. I have obtained much assistance and inspiration from the "Flora phanerogamique des Antilles francaises," by R. P. Duss (1896). (Bibliography No. 21). This book forms part of the journal of the Colonial Institute of Marseilles and is difficult to obtain in British Colonies. Had it not been for the great kindness of Sir Francis Watts (Commissioner of the Imperial Department of Agriculture for the British West Indies) who willingly lent me a copy of the Flora (along with other useful books of reference in the library of the Imperial Department) I should have been quite unaware of the existence of what is perhaps the best and most recent descriptive work on West Indian plants.

Part III of this volume deals briefly with the agents which have been responsible for the introduction of plants into Barbados.

The completion of my notes has been hurried somewhat by my having decided to collect the facts I have learnt during my residence in the Island, at a time not sufficiently previous to the date of my departure. The result is that there are many passages in the book which require revision. It is to be hoped, however, that what has been compiled will, in some measure, serve the purpose for which it was written.

Before concluding I should like to express my appreciation of the kindness of Professor J. P. d'Albuquerque, Island Professor of Chemistry, in making it possible for these notes to be prepared in type for the press, and for his continued interest in my work. I also owe my thanks to my esteemed friend Mr. W. Nowell (Mycologist of the Imperial Department of Agriculture and late Assistant Superintendent of the Barbados Department of Agriculture) for his constant help and valuable criticism. It is to Mr. Nowell that I owe inspiration and guidance in my botanical studies, and his kindness in offering to read through the proofs of this book is greatly appreciated by me.

F. HARDY,

Stafford House,
Bridgetown,
July, 1917.

SOME ASPECTS OF THE FLORA OF BARBADOS.

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SOME ASPECTS OF THE FLORA OF BARBADOS.

BY

F. HARDY, M.A., Dip. Agric.

CHAPTER I.

INTRODUCTION.

There are few subjects more thoroughly misunderstood by the average person than the Science of Botany. This fact becomes to a certain extent excusable when the reasons for it are exposed. Most people have some sort of an interest in the plants that grow around them—the interest being sometimes from the point of view of their beauty, sometimes of their use, and sometimes—though much more rarely—the interest is in the possible means whereby plants came to be evolved from simpler forms, and in what relation plants stand to other living things in organic nature.

Perhaps the chief reason why Botany is misunderstood by the layman is that he has received the impression that a study of it aims at teaching long, unwieldy and strange-sounding names for otherwise familiar plants, and at enforcing on the beginner a new language of technical terms which is at once formidable and unattractive. It is true that every plant so far discovered, possesses a botanical name which, by reason of its frequently having been founded on Latin or Greek words, is difficult to pronounce and more difficult to remember. It is also true that the botanist occasionally makes use of certain terms in order more definitely to describe a plant, but at the same time, it must be borne in mind that names are necessary symbols, and that a simple technical term might save line after line of verbiage—an important consideration when complex plant structures are to be described. In the earlier days, the student of Botany was chiefly concerned with plants considered as inanimate objects, consisting of many different and variable parts, each requiring careful tabulation and description. In those days also, while the Science was still in its infancy, much attention was paid to the recognition or discovery of new forms. The reputation of a botanist was then measured by the number of new species he had determined. It was even customary to use a sort of dog Latin in botanical writing of that period, and it is small wonder that the idea became prevalent, and was passed down from one generation to another, that Botany was a subject only for specialists. Here again, the idea became prevalent that, since

the specialists seemed to spend most of their time collecting and pressing plants—the important aim in every botanical excursion was to obtain as many "specimens" as possible. Many of these ideas are still held by most people, and even persons of undoubted intelligence and education exhibit the most profound ignorance of the real aims of the present-day botanist; even though by their conversation and behaviour, these people exhibit a certain amount of sympathy which, with a little botanical study may easily develop into real interest in the subject.

Botany nowadays has certain quite new aspects. It no longer consists in the preparation and arrangement of collected plant specimens, or in the committing to memory of scientific names of plants. It no longer deals exclusively with botanical descriptions, or with the determination of new species—although this part of Botany can never be neglected on account of the importance of correct delineation of plant forms with a view of tracing descent. On the contrary, modern Botany is for the most part a fascinating, common-sense pursuit, which adds much interest to one's walks abroad and which enables one to gain real insight into the workings of Nature. Of course, it is to be understood that there are many specialists whose work lies in one or other branch of Botany—in fact the whole subject is so broad and has so many meeting places with such subjects as Chemistry, Physics, and Agriculture that one may spend a whole life time in trying to learn all that is known about a single sub-division of Botany. Such a life's work, however, is the lot of few individuals,—but much that is of interest and value may be picked up in spare time by a naturally curious person, provided that sufficient inspiration and guidance is given in the first place to his early attempts to grasp the new ideas.

To put it briefly, Modern Botany aims at the elucidation of the problem of how the numerous plant forms we see around us came to be such as they are and where they are. It will be seen at once that this problem suggests two apparently different fields of inquiry. The first will be concerned with Evolution—that is, the gradual processes of change whereby one organism gives rise to others, and these in turn to further forms all of which differ in some respect from the ancestral type. The second part of the problem will deal especially with the ways in which plants become disseminated from the places where they were evolved, to other regions where they will come into competition with other already established plants and where they will be placed under conditions of life which may not be suited to them.

The Evolutionary aspect of the subject is perhaps the more difficult to grapple with and to understand. It involves a detailed investigation into the forms and structure of many different kinds of plant life,—from the very simple to the most complex;—an investigation which at once leads to endless lines of research, each necessitating the utmost care, ability and patience and often entailing the use of special instruments and of special technical methods of procedure. It also implicates experiments in plant-breeding which in themselves present numerous and often almost insurmountable difficulties. It can only be appreciated when some knowledge has been gained of the reasons why processes of change do go on in living organisms, and of the ways in which such alterations in form are passed on from parent to offspring. Many

readable books on this Evolutionary aspect of Botany are, however, unobtainable nowadays. The pioneer of them is, of course, Darwin's "Origin of Species"—a book which did more to awaken interest and to initiate wide research in Evolutionary Biology than any other exposition has ever done. A list of easily procured and attractive books on Evolution is given in the bibliography at the end of this volume. The issue in recent years of several excellent, popular editions of scientific books makes it possible for every educated person to know something of the underlying principles and the modern trend of thought in this branch of Science, and to make himself acquainted with the main results of investigations of specialists.

The second aspect of Botany on the other hand is one which can be studied and in part first hand without the application of any very special methods, and by any lover of nature who is willing to look more closely into things around him than is his wont to do. It is with this second aspect of Modern Botany that it is intended to deal in the following chapters,—the Flora of Barbados furnishing data by means of which many interesting and important biological principles may be illustrated.

The plants of Barbados then are to be examined in such a way that insight will be gained into the methods whereby a particular land area may become populated with plants, and into the factors which govern the distribution of those plants once they have gained access to that area.

It will be advantageous to investigate the latter of these questions first. When we have learnt why certain plants have come to grow only in certain regions of Barbados, and when we have incidentally become acquainted with the composition of the flora of the Island, then we shall be in a position to discuss the origin of that flora and to understand how it came to be introduced into the Island in the first place.

PART I.

THE FACTORS WHICH GOVERN THE DISTRIBUTION OF PLANTS IN BARBADOS.

CHAPTER II.

CLASSIFICATION OF THE FACTORS.

It is an obvious fact that the vegetation of Barbados varies from place to place. Most of the Island it is true is under cultivation, but there still exist a certain number of uncultivated regions (such as sea beaches, gullies, rocky waste places and roadsides) each of which, on examination, is found to possess its own characteristic assortment of plants. In a canefield even certain wild plants grow up with the canes and might eventually seriously affect their vigour were it not for the very particular care taken to keep them in check. These cane-field "weeds" (as will be pointed out in a later chapter) consist of distinctive plants —the identities and characters of which will be subsequently given. It will be found that they are of constant occurrence in cane-fields and one therefore soon learns to associate their names with this habitat.

In dry pastures close by cane-fields, few or none of the cane-field "weeds" are to be seen, while in gullies and on sea-beaches the assortment of plants again differs from that in either of the two regions, and is itself distinctive in each. Such facts as these serve to indicate that plants are distributed, not singly and haphazard, but in groups which more or less characterise the regions which they occupy. Thus the plants of cane-fields in any part of Barbados are of the same general type,—those of dry pastures of another type,—those of gullies of another; and so on.

Plant-groups which characterize certain definite regions where the general conditions are the same, as in the examples cited, are called by Botanists, Plant Associations.

In Barbados then, one may distinguish several Plant Associations, and it will be the object of subsequent chapters to examine into the nature of these and to try to learn from a study of them the reasons why plants come to be grouped together in such a constant and definite manner.

Turning our attention now to the factors which have influenced and are still influencing the vegetation of Barbados, and which have brought about the aggregation of its plants into plant associations, we realise at once that these factors are numerous and varied, and are of different degrees of importance accordingly

as they affect its general nature or the nature of its minor details. It is common knowledge, for instance, that climate determines what the general nature of the plants populating a certain region will be, for we have Arctic plants, Tropical plants and Temperate plants—each of which group constitutes a definte "Zone of vegetation." Within each zone of vegetation many smaller plant communities exist. Their nature is decided by factors such as surface -configuration, soil characteristics, porosity of the underlying rocks, &c.—factors which play an important part in connexion with the vital question of water supply. Lastly, many other factors—most of them of great complexity and of marked inter-relationship, affect the distribution of plants within the areas whose limits are defined by the more direct agencies. Of these factors, man's influence on the vegetation stands out as being particularly effective and interesting, especially in connexion with the problem with which we are immediately concerned.

From the foregoing remarks it becomes evident that an investigation into the reasons why the plant population of any land area comes to be what it is, and to exhibit marked aggregation into plant associations, is one of no little difficulty. It involves the use of considerable judgment and experience in assigning to the several factors at work their proper values.

The study of the plant associations of different areas in relation to the various factors of growth in operation in those areas is termed "Plant Ecology." (Greek oikos—a house).

Ecology as an organized study is a recent development of Botany, and was only taken up by British Botanists in the last fourteen or fifteen years. It owes its origin to Professor Warming—of the University of Copenhagen—whose book "Oecology of Plants," published in 1895 (with an English edition in 1909) is still the standard exposition of the subject.

Detailed study of any one Plant Association along ecological lines will soon indicate that within the Plant Association many smaller groups of plants may be distinguished. In a rocky district, for instance, some plants may be found growing on the bare rock itself—their roots penetrating into the pores and crevices of the rock,—whereas others are confined entirely to the pockets of soil which occur between the stones or which break up their surfaces.

The smaller plant-groups within a plant association are called "Plant Societies."

Another example of a Plant Society is the collection of plants that grows in the moister hollows or depressions in a Dry Pasture Association, and another, the group of plants that chacterises the tops of hummocks or ridges in the same association.

Before proceeding to a description of the different factors which decide the distribution of plants, mention must be made of the way in which plants growing in a given association influence each other. Take for instance the case of Forest Association. Such an association of plants includes tall trees, smaller trees and shrubs, and also many undergrowth herbs. The taller trees and shrubs shade the herbs and thus make it possible for them to live by preventing their exposure to too strong light. The presence of the trees thus decides to a certain

extent the kinds of lowly plants that can populate the soil which forms the floor of the forest. In this example, the trees are said to be the *dominant species* and the undergrowth plants, the *subsidiary species.* Thus, if the dominant species of a Forest Association are tall and not overcrowded, small plants requiring shade might grow beneath them, whereas such plants would have no chance of surviving in an association in which the dominant species were low-growing. In a typical, well-established plant association there is, therefore, a balance between the several species constituting the association—since the requirements of each kind of plant are different and the "struggle for existence" between the species is not very severe.

Turning our attention now to the nature of the factors that may influence the distribution of plants, we find that it is possible to classify the factors into four major groups. Each of these groups may be further sub-divided in a way which will be best illustrated by a tabular representation of the scheme of classification to be adopted in this book.

(I) *Climatic Factors* which act over large areas and which decide the general nature of the vegetation in such regions as Arctic regions, Temperate regions and Tropical regions. They depend on geographical situation, latitude, altitude and upon the earth's motion.

They include

1. Temperature
2. Rainfall.
3. Amount of sunshine.
4. Direction and force of the prevailing winds.

II. *Topographical Factors* which are decided by the configuration of the land and which act within the areas whose vegetation is decided broadly by the climatic factors mentioned above.

They include :—

1. Effect of altitude, slope, &c. which indirectly influence vegetation because of their effect on rainfall.
2. Effect of land masses or depressions in sheltering vegetation from winds.
3. Effect of surface features, porosity or rocks, &c. on the movement of water which has fallen on to the land as rain.
4. Effect of slope of land which influences the depth and drainage of the surface soil.

III. *Soil Factors.*

These include :—

1. *Physical properties* of the soil, which decide its moistness, its aeration, its drainage, &c.

2. *Chemical constituents* of the soil which decide the nature of the nutrient salts which it supplies to plants growing in it.

IV. *Biological Factors.*

These include :—

1. The influence of animals and man.

2. The influence of the plants on each other.

The above factors include the most important factors in operation in all parts of the world. They are instrumental in deciding the ultimate nature of the vegetation in any locality on its surface. In particular, each has played its part in bringing about the final arrangement of the plants found growing in Barbados, and many of them are still in operation there, so that their methods of working may be studied at the present day.

It is proposed to consider in turn each factor in connexion with the question of the distribution of plants in Barbados, and at the same time to attempt to decide which factors have made the greatest impression on the present-day vegetation of the Island.

CHAPTER III.

CLIMATIC FACTORS.

1. *Temperature* is of importance in deciding the general nature of the plant life of any country, because many of the processes that go on in the plants are directly influenced by it. Some plants can stand high, some low temperatures—whereas others live successfully only in surroundings where the temperature range is small. Thus Arctic plants are specially suited to life under low temperature conditions, and could not possibly exist in temperate or tropical countries.

In Barbados, and in the Tropics generally, then, only certain kinds of plants can live. Other plants such as many of those which are characteristic of temperate or arctic regions (for example, conifers and other common forest trees of northern latitudes) cannot exist there—although certain plants (for example, a number of weeds of cultivation and a few common garden plants) can thrive quite as successfully under tropical heat conditions as under those of temperate countries.

Records of the air-temperature of Barbados indicate that neither the diurnal nor the annual temperatures show any great extremes. The average annual maximum temperature is about 84°F. and the average annual minimum about 75.5°F. The temperature seldom rises above 88°F., and only occasionally falls below 67°F.

It may be concluded from these data that the soil in which the plants of Barbados grow is not subjected to seasonal changes as regards heat and cold as is the soil of temperate or northern countries. Hence the process of water absorption carried on by the roots of those plants is never suspended, but proceeds uniformly, provided always that there is a sufficient supply of water to be absorbed. In regions where summer and winter temperatures succeed one another the absorption process—influenced as it is by temperature changes,—falls off during the cold weather, and is initiated again in spring when the temperature rises. This temperature change in temperate countries, results, therefore, in a marked seasonal alternation of vegetative activity, most plants dying off or dropping their leaves in autumn and winter and springing to life and putting out fresh foliage in the spring and summer. In Barbados then, seasonal changes in plants as a result of temperature effect, are not marked. It is true that many plants do show variations in their vegetative processes, but these variations are due to the fact that the water supply is not constant—a result brought about by the increase and decrease of the rainfall during the "rainy" and "dry" seasons respectively. This point will be dealt with later when the rainfall factor is discussed.

2. *Rainfall* is of very great importance as a factor influencing vegetation in any region, since water is such an essential need in the life of every plant.

Water is undoubtedly the chief agent in determining plant distribution in every sense of the term. It will be shown later that plants differ greatly in their water requirements. Some are so constructed that they require little water at their roots—since they lose so little of it by evaporation (or "transpiration") from their leaves and stems. In other words, they are adapted for life under comparatively dry conditions. Other plants, however, cannot live unless the water supply is good, and others again can exist only when totally submerged in water. The rainfall of Barbados is, comparatively speaking, low. It has averaged about 62½ inches per annum for the last 60 years,—a marked contrast, for instance, with the rainfall of the mountainous Island of Dominica which approximates to 130 inches, and in certain districts, to as much as 300 inches per annum.

The lowness of the land in Barbados, and the absence of forests probably account in part for the smallness of the rainfall. When the Island was densely covered with trees, doubtless the annual rainfall was much higher than it is today, since the cooling effect of trees on the atmosphere into which the sea breezes bring moisture-laden air is known to bring about precipitation of that moisture in the form of rain.

The distribution of the rainfall in Barbados shows to a marked extent the influence of altitude on the quantity of rain which falls on the land. The highest parts of the Island have, in general the highest rainfall. The low lying districts in the south east of the Island suffer very considerably from drought, and it is only by careful husbandry that satisfactory results can be obtained with the crops growing there. Other low lying regions such as those that occur in the north of Barbados and along the windward coast, also frequently suffer from drought, but not to the same extent as in the other area mentioned.

The effect of rainfall in deciding the general nature of the Flora of Barbados is very great. In the first place, the fact that the Island is on the whole very much drier than neighbouring Islands such as St. Vincent, Dominica and Trinidad, is responsible for the paucity of species represented in its plant associations. Very many plants that are found growing successfully in the moister Islands of the West Indies are never found in Barbados, and it is probable that even when the Island was uninhabited by civilised man, the flora was never so rich as that of those Islands.

Secondly, although the amount of rain which falls in different parts of Barbados considerably affects cane cultivation, yet its direct influence on the wild plants of the uncultivated regions is not very pronounced. This is because the water supply of the plants of the present-day plant associations represented in Barbados, depends more on topographical and soil factors than on the superficial variations in the amount of precipitation over the different regions of the Island .

During the months of June to November the weather in Barbados is usually rainy. This period is called the "rainy season" by planters—but even during these months the showers are generally quite local—one district receiving three or four inches of rain, while another, not many miles away, receives little or none. On the average about 45 inches of rain fall in the rainy season, while the remainder (17½ inches) falls in the "dry season" extending from December to May. During the dry weather in Barbados many plants drop their leaves. This

is especially noticeable in the case of several species of trees whose characteristics will be set out in full in another place, where the probable reasons for the marked periodicity in the vegetative activity of these trees will also be stated.

3. *Amount of sunshine.* This varies in different latitudes—for in northern countries the relative lengths of the day and the night differ from those in the tropics. Light is absolutely essential to the growth of green plants. On it depends their ability to build up food materials from the simple substances which they absorb from their surroundings. Many plants require bright light for success—others can live only in deep shade.

In Barbados the light conditions are exceptionally good. There are few cloudy days except in the middle of the rainy season,—and the length of the day varies but one or two hours in the different months of the year.

4. *The direction of prevailing winds* influences the distribution of the rainfall over any given land area, and thus indirectly influences the vegetation. Windward slopes of mountains and hills catch the moisture brought by the wind, while the leeward slopes remain much drier. *The force of the wind* decides to some extent what plants can survive on a given area of land because, first of all wind dries up the soil at a rate depending directly (but not entirely) on its velocity; secondly, it dries up plants unless they are specially constructed so that they lose water only slowly; and lastly, it so affects the growth of young stems, buds, &c. that it prevents many plants from becoming established on areas exposed to it, and influences also the growth forms of those plants (especially trees) that manage to survive its blast. The force of the prevailing wind is frequently also sufficient to cause an accumulation of loose surface debris, (such as sand in deserts or on the sea shore) in certain districts of a wind-swept country. Such accumulations as sand dunes influence to a marked degree the nature of the vegetation that is able to thrive on a land area covered by them.

In Barbados, the chief prevailing wind is the North East Trade Wind, which blows over the Island for the greater part of the year, with great persistency, and often with considerable violence. It exerts a marked influence on the vegetation. It is instrumental in drying up the surface soil; in drying up plants not specially constructed to resist desiccation; in bringing about peculiar growth-forms in certain trees and shrubs especially exposed to it, and in producing, in certain localities along the windward coast, small sand-dunes whose vegetation is characteristic and peculiar.

Barbados is also subjected to occasional south-easterly gales which come from the northern regions of South America. They blow spasmodically during the rainy season, but probably have little influence on the vegetation of the Island, except in so far as they affect the rainfall. Undoubtedly in former times when the Island was uninhabited by man, the effect of the prevailing winds on the vegetation of Barbados, was much less marked than it is to-day, since in the early days the outer belt of forest must have sheltered the inner regions from the deleterious action of strong and persistent air movement.

CHAPTER IV.

TOPOGRAPHICAL FACTORS.

In order to gain some idea of the influence which the topographical features of Barbados have excited on the distribution of plants, it is advisable to study the structure of the Island from a geological standpoint, for on its geological structure, the surface features depend. Further, the question of the origin of Barbados, that is, the history of its formation as an Island, is intimately bound up with the question of the origin of its flora. This latter aspect of the subject is to be treated specially as a separate part of this book.

GEOLOGICAL STRUCTURE OF BARBADOS

Barbados is the most easterly of the group of West Indian Islands known as the Lesser Antilles. It does not lie in the general chain of this group, but is distant some 90 miles from it—St. Vincent being its nearest neighbour. Soundings made between Barbados and other Islands in its vicinity, indicate that it is surrounded by great oceanic depressions. In many places the depths registered are between 1,000 and 1,500 fathoms—so that Barbados truly may be said to be a completely isolated land mass.

The geological structure of Barbados is comparatively simple. The Island consists of a core of sedimentary rocks, almost completely encased in a covering of coral limestone.

The core is exposed in the "Scotland District" in the north of the Island, and includes a series of much folded beds of sandstones and clays (the "Scotland Series") succeeded by white, siliceous and calcareous "earths" and clays, (the "Oceanic Series").

The coral limestone covers about six-sevenths of the whole surface area of Barbados, but it is nowhere much thicker than 260 feet.

Owing to its formation as a series of coral reefs, laid down during the gradual uplift of the central core above sea level, the limestone stands out as conspicuous terraces which form an important element in the scenery of the southern and western parts of the Island.

The geological age of the "Scotland Series" is stated, on fossil evidence, to be early Tertiary—or even Cretaceous—while that of the overlying "Oceanic beds" is almost certainly late Tertiary (Pliocene or post Pliocene).

It is certain, therefore, that Barbados was in no way connected with the mainland or with other Islands of the Antillean chain during the period of its latest emergence, which conclusion furnishes the chief reason for classifying Barbados as a true Oceanic Island.

The period of its final emergence from the sea probably coincides with the Great Ice Age—an era in Geological history marked by the advance in Northern Latitudes of extensive glaciers which have left their mark on the superficial features of the whole of Northern Europe and America. The commencement of this emergence also coincides with the date of the earliest records of Man upon the earth.

TOPOGRAPHICAL FEATURES OF BARBADOS

Barbados has an extreme length of 21 miles and a width of 11 miles measured across the southerly part of the Island,— and of 5 miles across the northern part. Its total area is 166 square miles, so that Barbados is about the size of the Isle of Wight. The greatest elevation is 1,104 feet, at Mount Hillaby—a point in the rim of the much denuded core of the "Scotland District". This rim or ridge describes an almost semi-circular curve whose extremities abut on the north eastern sea coast. Its height for a length of several miles is between 1,000 and 1,100 feet above sea level. The surface features of the land within the limits of this ridge, that is, the surface features of the Scotland District, differ very markedly from those of the rest of the Island. It would be advisable, therefore, to consider the two regions separately.

1. THE SCOTLAND DISTRICT.

This district includes ridges of hills which project from the outer rim more or less radially and with a north easterly trend, towards a centre, whose position is in the vicinity of St. Andrew's Church. The natural drainage of the district is carried out by a system of small water-courses (dignified by the names of rivers on maps of Barbados) which start from the rim of the area and flow in a north easterly direction to the sea. These watercourses commence as narrow, steep valleys which contain water only in the rainy season. They quickly fall into a low level where they spread out into broader valleys—many of which are so extensive and so filled with debris washed down from the Scotland heights, that they might properly be termed alluvial flats. The main arteries of the drainage system, namely the two branches of the St. Andrew's river, are situated for the greater part of their length in extensive alluvial flats which reach a maximum development at Belle Plaine. It is quite obvious even to a cursory observer that the insignificant streamlets that now occupy the valleys of the Scotland District could not have produced the profound effects that one sees in the topographical features of the land surface in its present configuration. To have produced these effects the rainfall of Barbados must have been much heavier in former times than it is to-day, a fact that has great bearing on the question of the nature of the flora of the Island before the advent of man produced such profound changes in its composition.

The rain which falls on the land in the Scotland District at the present day at once flows down the steep hillsides—washing much of the loose debris with it—and is quickly carried by the network of small valleys into the chief drainage arteries of the district and thence to the sea. Hence the valleys and the alluvial flats are well watered whereas the steep hill and slopes remain for the most part parched and dry.

2. THE CORALLINE REGIONS OF BARBADOS.

The outer coralline portion of Barbados to the South, West and North-west of the Scotland District stretches from the rim of the central core on the three sides roughly in two broad, step-like plateaux, each of which includes numerous minor plateaux or terraces.

(a) *Uplands.*

The first plateau immediately encircling the Scotland District has a width of about 2½ miles in the northwest,—this width narrowing down to 1½ miles in the long strip of upland that runs southward for a distance of fully 7 miles and broadening out again as it bends round the south-western boundary of the Scotland District, to a maximum width of some 4½ miles as measured in a northwest to south-easterly direction across the Parish of St. John. The plateau finally terminates at the escarpment that faces east and overlooks the railroad in the Parishes of St. Philip and St. John. Let us deal with this first plateau in its two natural sections, the north-western and western section and the southern section. The first section lies in the Parishes of St. Lucy, St. Peter and St. James and joins the second section in the parish of St. Thomas. It falls in elevation gradually from an average height of some 780 feet at the rim of the Scotland District to an average height of some 480 feet above sea level at its north-western and western border where it terminates abruptly at a line of inland cliffs. In the north, these cliffs are not very pronounced nor very high—but rather take the form of gently rounded slopes. At Mount Gilboa, however, the escarpment takes on the form of an almost vertical wall which is continued southwards at an average height of about 80 feet above the level of the land at its base, for a distance of 8 or 9 miles. This line of cliffs forms a very conspicuous feature of the landscape in the leeward part of Barbados. Its uniformity is broken only by the numerous ravines (or "gullies") which, starting near the rim of the "Scotland District," cut through the line of cliffs and divide it up into a series of blocks. Many of these gullies contain an interesting association of plants,—one of them—Sion Hill Gully—being worthy of special notice since, because of its difficult accessibility, it has not suffered much interference by man.

Turning our attention now to the southern section of the first plateau, we notice at once that the land here takes on the general form of a broad depression. This depression is bordered on the north by the well-marked limestone escarpment which abuts on the Scotland beds between Castle Grant and Society Church—and part of which forms the well-known landmark of Hackleton's Cliff. The crest of this escarpment reaches an altitude of some 1,000 feet,—the vertical cliff wall at Hackleton's Cliff being about 70 feet high. The depression falls when traced southwards in a series of low terraces (of which that bearing Mount Tabor Church is a good example) and eventually rises again to the crest of the gently sloping and continuous escarpment which crosses at an average altitude of some 550 feet, the whole of the parish of St. George, and forms a sort of backbone of the coralline part of Barbados. The general uniformity of the upland depression described above is interrupted only by a ridge of height about 150 feet above the level of the land at its base, along the crest of which runs the road past Gun Hill, Golden Ridge estate and Pool

estate. The soil and climatic conditions in the St. George and St. John regions as so favourable to plant growth that the cane crops of this district are perhaps the best of any produced in the Island.

At several places in the southern section of the first plateau whose general features have been outlined above, many deep, narrow, dry valleys, some of them of very considerable length, cut through the plateau and the escarpment which forms its southern border. These deep valleys are known as gullies. They are especially abundant in the western part of the area—that is, in the parish of St. Thomas. It was formerly supposed that their origin was due to volcanic or earthquake agency, but this idea is entirely refuted by Harrison and Jukes-Brown in their "Geology of Barbados," p. 6. The true reason for their formation is stated (loc: cit: p. 45) to be the action of running water—a conclusion arrived at only after a full consideration of the characteristics of typical gullies, and of the relative efficacy of other possible methods by which they may have been produced. According to this explanation, the gullies must have been started when only a narrow fringing reef surrounded the central dome-shaped core of Barbados. As this core was gradually uplifted, the water courses were deepened and continued, until eventually they traversed the whole of the elevated area.

(b) *Lowlands.*

Considering next the second or lowland plateau which extends between the sea coast and the escarpment bordering the first plateau, we again find that this lowland area may conveniently be divided into two sections,—a northern and a southern.

The northern section includes the nearly flat land of the Parish of St. Lucy to the very north of Barbados, together with the strip of land, of average width 3 miles, which lies between the leeward sea coast and the line of vertical cliffs bordering the first plateau, in the Parishes of St. Peter and of St. James. In St. Lucy the flat land is terminated by high rugged sea cliffs, but in the other parishes the ground falls in a series of low terraces to a narrow sandy beach. In the southern part of this section as many as four of these terraces may be counted.

The southern section of lowland is of large area. It includes the land within the parishes of St. Michael, part of St. George, Christ Church and most of St. Philip. It is traversed by a broad valley in the trough of which runs the railroad which passes near Bulkeley, Carrington, and Three Houses. There is thus in the very south of the Island between this trough and the sea coast—an elevated region which may be called the Christ Church ridge. The land falls on either side of this ridge (whose height is nowhere much more than 350 feet above sea level) in a series of low terraces—of which those near the southern sea coast are of especial prominence. The elevated land gradually decreases in height eastwards until it merges with the low flat land that borders the sea cliffs in the region of the Crane and Lord's Castle.

3. THE SEA COAST OF BARBADOS.

Having considered the features of the surface of Barbados in some detail,

it would be fitting to conclude this topographical account by describing briefly the nature of the sea coast of Barbados, — since this has considerable bearing on the different kinds of plants that are to be found associated together in the coastal regions.

The features of the sea coast of Barbados vary considerably from place to place in accordance with the kind of exposed rock and with the nature of the agents of weathering which have been responsible for the formation of the coast line of the Island.

Considering first the coralline region of Barbados, one notices that along the eastern and south-eastern coast, for a distance of about 12 miles, and again along the northern coast in the Parish of St. Lucy, for a distance of about 9 miles, the sea is bordered by steep limestone cliffs of height between 20 and 60 feet. These cliffs offer a jagged resistance line to the tearing action of the waves which beat against the land with great violence. Were it not for the presence of the encircling coral reefs which run almost the whole length of the coastal sectors under consideration, and at an average distance from the land of about 2 to 3 miles, the sea cliffs would receive the full force of the waves of the Atlantic which would cause them to be denuded at a much greater rate than at present. As it is, the cliffs in places along the south-east coast of Barbados and also of parts of the northern coast, are being broken up at a rapid rate. In historic times large pieces of the cliff face have been known to fall away into the sea and, judging by the presence of detached rocks which lie at some distance from the coast near North Point, it appears that the line of cliffs once extended much further seawards (at least in the northern part of the Island) than it does at the present time.

By reason of the great irregularity of structure and of hardness in the exposed coral rock of the sea cliffs, the features of the cliffs change rapidly from place to place. The softer coral rocks are worn away faster than the more resistant material so that the former are hollowed back into bays and inlets whilst the latter stand out as headlands. In the face of a cliff also, the resistance of the rock to the action of the sea is variable. For instance, in the north of Barbados near North Point one notices two distinct layers of coral rock exposed in the cliff-face. The upper layer is on the average about 20 feet thick and is composed of rounded lumps of coral filled and cemented together as if it were the work of a mason. The lower layer is of compact limestone and resists the action of the sea much better than does the softer upper layer. The waves have produced in places a well-marked shelf of rock whose surface is in the same plane as that which separates the two layers above-mentioned. Many caves have been produced in the softer zone above this— one of them— the "Animal Flower Cave" being of considerable extent and containing several basins in which species of Sea Anemone occur, protruding from carpets of green, crimson and salmon-coloured marine algae or sea-weeds. Here and there along the coast compressed air has produced "Blow holes" which now allow the escape of the air imprisoned in the caves and fissures by the waves as they rush forward against the cliffs. On the whole then, the sea cliffs of the coralline parts of Barbados are extremely rugged and irregular, and are constantly exposed to the waves or to salt spray that bathes them.

On the western and southern coast of Barbados the land is not exposed to the denuding action of the sea to any great extent, since the sea currents and the prevailing winds beat only against the north, north-east, east and south-east of the Island. Here there are no sea-cliffs of any importance along this coast—which extends for a distance of about 24 miles in all. For a length of 15 miles for instance, the almost straight leeward coast of Barbados meets the sea at a low-lying, sandy beach which only occasionally reaches a width of 20 yards. The remaining 9 miles of coast along the southern part of the Island, consists of low rocks with strips of sandy beaches at their bases. Only at their easterly extremity where they merge into the south-east coastal border near Christ Church Almshouse, can these rocks be said to constitute a sea-cliff.

At several places along the coast where sea-cliffs exist beaches of sand of appreciable magnitude occur. It appears that at these places the ultimate particles produced by marine denudation have been washed up by the sea at the foot of the sea-cliffs (usually in inlets where the sweep of the on-shore currents is arrested) and have there produced sandy tracts of occasionally extensive dimensions. The most noteworthy of these beaches of the coralline regions of Barbados are those at Maxwells, on the south coast; at the Crane; at Long Bay (Lord's Castle); at Foul Bay; at Long Bay (Chancery Lane) and below St. Ann's Fort at the Garrison, near Bridgetown. Many other beaches of lesser extent occur at different points round the coast of the coralline part of the Island, and it is an interesting fact that in many places, old beaches are disappearing (or have disappeared in recent times) and new beaches are being built up. Thus along the south coast, near Hastings, a beach of considerable width existed previous to about 30 years ago,—but is at the present day quite inconspicuous. The sea now washes up to the low cliff which once backed this beach at a distance of some 20 yards from high water mark. At another place about 2½ miles to the east of the above, near "Calais" the sea is depositing stones and sand on the beach—which is thereby being enlarged and extended. Within a few hundred yards of this spot, and to the east of it, a wide beach of sand has in recent years been left high and dry by the sea receding to a distance of over two hundred yards from the edge of the low cliffs that once formed its land margin. This beach is to be described in detail later. All along the southern coast of Barbados re-adjustments of the sea border are continuously going on and so quickly as the new land is exposed, just as quickly do the plants of the sea-shore invade the region and colonise it.

Considering next the Scotland district of Barbados, one notices at once a great difference between the features of the coast in this region and those of the coralline region just described. For the greater part of its length (which is in all some 10 miles) the shore is sandy and of average width about 50 yards—except where the alluvial flat known as "Belle Plaine" opens out to sea—in which district the beach is much wider. The ground rises gradually from the beach (or from the alluvial flat of Belle Plaine) and merges with the slopes which terminate the radiating chain of hills proceeding from the rim of the Scotland District. In places along the shore, the inner margin of the coral reef fringing this part of the Island protrudes through the sand exposed at low tide. The flora of the Scotland district beach differs but little from that of typical beaches in other parts of Barbados. Near Belle Plaine (at Long Pond) and in places along the shore between Round Rock and Chalky Mount, a series of well-marked sand-

dunes occur, and these support a vegetation which will be described separately anon.

Let us now review what we have learnt about the general structure and topography of Barbados and apply the facts in order to try to make clear the relation between geological and topographical factors and the nature of the vegetation of the Island.

The effect of altitude is the first important point for consideration. No region in Barbados is much over 1,000 feet high, and the absence of mountainous country in the Island has in part, a great influence on the rainfall,—causing it to be so low that the growth of many kinds of plants is entirely prohibited. Also the lesser influence which the variations in level have on the distribution of rain within the borders of the Island, again affects to some small degree, the character of the vegetation. These results, however, need not again be considered here as they were dealt with under the heading of "Rainfall" in a previous section. Further, the general effect of the flatness of the greater part of the land in Barbados in not preventing the prevailing winds from blowing over it, is of no small account in limiting vegetative activity in the exposed regions. The ways in which the wind-factor acts in this connection have also been considered in a previous section. On the whole then, the effect of altitude on the vegetation of Barbados is an indirect effect, since it operates by influencing the rainfall.

The other factors connected with the structure and the surface features of Barbados, such as the effect of slope, of depressions in sheltering certain places from wind, of porosity of rocks and drainage systems in governing the flow of water which has reached the land as rain, differ so markedly in the two regions of the Island (the Scotland district and the coralline region) that their investigations might best be carried out under two headings.

1. *The Scotland District.*

In describing the surface features of this region mention was made of the effect which the natural drainage system of the district has on the water supply of the land in the valleys on the alluvial flats and on the hill slopes. Whereas there is not much chance of water accumulating in the shallow soil which covers the hill slopes, the case of the deeper valleys and the alluvial flats is quite different. The water supply here is good. In the flats the soil is deep, rich and of good tilth. It retains moisture well and is of an ideal nature for cane cultivation. On the slopes, vegetation is almost absent. The hillsides are for the most part naked, brown and barren,—except where clothed with a scanty, dry, grassy or scrubby vegetation, or coaxed into arrowroot plots by an industrious peasantry. The exposure of the hills to the direct winds from the Atlantic further aids in producing almost complete desiccation on their more windward slopes. In the valleys, however, the land is sheltered, and many of them are sufficiently moist and quiet to fit them for the growth of several kinds of fruit trees which flourish extremely well in these parts of Barbados —although not cultivated to a sufficient extent to allow of an export trade in their products.

The above account is enough to indicate that the configuration of the land in the Scotland District is primarily responsible for the distribution of plants, both wild and cultivated within the area. The steep hill-slopes, the extensive alluvial flats and the narrow upland valleys present to plants, habitats characterised by great differences in water supply and in depth of soil, so that, here again, topographical features are seen to influence vegetation in an indirect way, and chiefly by reason of their influence on water supply.

2. *The Coralline Region of Barbados.*

The land in this region is not drained by a natural system of water courses as in the case of the Scotland District. In fact the movement of water which falls as rain in the coralline region is quite peculiar and is especially worthy of study. It has influenced to a large extent the distribution of wild plants and has played an important part in fixing the limits of certain plant associations now found in Barbados. Further, it has also influenced to a great extent the methods of cultivation practised as the outcome of experience gained by the early planters. The surface of the land of the two plateaux into which the coralline part of Barbados was, for convenience of description divided, is broken up into numerous hollows or "bottoms" which at one time must have been filled in the rainy season with water. It was the custom of the early planters to remove this stagnant water by digging sinks or "sucks" at low points in the hollows. The more compact upper layers of coral rock were cut through and the water, falling down the sinks, came on to the pervious and tunnelled lower layers of coral and could thus get away quickly. The reason why such a system of removing accumulated water rapidly instead of allowing it gradually to soak into the subsoil and into the rock below, was undoubtedly to increase the area of land which could possibly be used for cane cultivation, — an object which has been pushed so far that very little unused land capable of supporting crops exists in any part of Barbados at the present day. A simple means of conserving water by permitting it to accumulate in natural hollows in the ground has thus been sacrificed in Barbados for the sake of increasing the area of cane land. The porous nature of the coral rock, however, causes it to retain much of the water that percolates into it during wet weather. It is true that some of the water eventually finds its way into the underground watercourses which are known to ramify within the limestone in all parts of the Island, and thus to escape to the sea, but it is quite certain that the mass of coral of which the major part of Barbados is composed, absorbs, — spongelike — large quantities of water which it gives up again during the dry season. The lateral percolation or "seepage" of this subterranean water is made evident in the comparative luxuriance of the vegetation which occurs in the "undercliff" regions lying at the bases of many of the terraces which characterise the limestone districts of Barbados, and in the occasional springs which emerge from the ground in many of the undercliff localities. In fact the chief feature to lay stress on in connexion with the effect of the structure and topography of the coralline region of Barbados on the vegetation of the Island is this ability of the coral rock to absorb and retain water. The apparently remarkable character which the cane plant is locally credited with possessing, being able to live through periods of severe drought, is really in great part due, not to any special features of the structure of the plant itself, but rather to the peculiarity in the water supply with which it is provided.

Turning our attention now to the gullies which dissect the coralline region of Barbados in many districts, we notice here a very marked effect of shelter on vegetative activity. The gullies do not serve as water courses except in very wet weather, but they do tend to accummulate water which percolates into them from the surrounding coral masses. This water is only removed at a slow rate by evaporation, since by reason of the narrowness of the gullies and the steepness of their sides, the persistent winds which do so much to dry the soils in the fields bordering the gullies, do not reach them. This fact, coupled with the comparatively small disturbing effect which the activities of man have had on the vegetation growing in gullies, is mainly responsible for the luxuriance and distinctiveness of the plant associations characterising these peculiar ravines.

Before leaving the subject of the influence of topography on vegetation in the coralline parts of Barbados, mention may be made of the effect of slope on the depth of the soil which occurs in different localities of this region. The hollows or "bottoms" are known to contain a greater thickness of soil than the ridges and knolls. Further, it is to be gathered from the account of the soils of Barbados in the pamphlet on the "Geology of Barbados" by Harrison and Jukes-Brown that much of the material of the "black" soil of the lowland districts has been brought down from higher levels by the action of rain and surface water.

CHAPTER V.

SOIL FACTORS.

So far we have seen that the general nature and distribution of the vegetation in different parts of Barbados, whether that vegetation be natural or cultivated, has been decided to a marked extent by the climate and the topographical features of the Island. When we come to consider the minor details of plant distribution, we find that the nature of the substratum in which the different assortments of plants are living, plays an important part in deciding the limits of the area inhabited by them. By "substratum" it is meant to imply, not only what is ordinarily known as soil, but soil and the material which underlies it, namely, sub-soil and solid rock. Of these three layers of a substratum, the lowest, namely solid rock, may be porous or non-porous. Amongst kinds of rock that are porous may be mentioned coral limestone, chalk and sandstone, and amongst non-porus rocks, slate, clay and granite may be taken as examples. The conditions of growth of any plant are intimately bound up with the nature of the substratum in which that plant is growing. There are five considerations which decide whether or no a plant will grow successfully in its habitat. They are (1) Water supply, (2) Air supply, (3) Root room, (4) Soil Temperature, and (5) Nutrients in the Soil. If these five factors are suitable to the requirements of a plant which starts life in a particular habitat, then that plant will continue growth and will thrive successfully.

1. *Water Supply.*

This term is meant to include, not only the total amount of water contained in the soil in the immediate neighbourhood of the root-system of a plant, but also the ease with which this soil can be kept moist by the passage of water from the surrounding substratum. Water supply depends primarily, of course, on rainfall. It also depends on the ability of the substratum to absorb the rain that falls on its surface, and on the power of the substratum to retain that water and to store it in such a way that it may gradually become available to the plants growing in it.

A substratum whose upper layer consists of good loose soil can absorb water almost as quickly as it falls on it as rain, and, provided that the sub-soil and rock below are also porous, much of this water can be passed on to the underlying layers which will thereby act as a storage reservoir. On the other hand, a substratum whose upper layer consists of only a very thin layer of soil will have little chance of absorbing water since rain will quickly run off its surface.

The conservation of absorbed water by a substratum whose upper layer consists of deep soil is also much better than that by a substratum which possesses only a thin layer of soil, for a thick layer of soil acts as a protective covering, minimising loss of water by evaporation. This protective action is rendered even more effective when a layer of dead vegetation (for example cane "trash") lies upon the surface of the soil.

For a soil to make the best use of the water with which it is supplied, that is, for it to retain the maximum amount of that water and to store it up in such a way that plants growing in the upper layers of the soil will be able to draw on it as they require it, that soil must possess certain physical properties which are shown by practical and theoretical considerations to depend chiefly on its *texture.* By "texture" is meant the structure of the soil as determined chiefly by the relative size of the particles of which it is composed, and by the mode of packing or arrangement of these particles. Amongst the physical properties of soil, the following are the more important and have direct bearing on water supply:—

(a) *Capacity*—decided by what percentage of the total volume of the soil is pore space.

(b) *Porosity*—decided by the average size or area of section of the pore spaces.

(c) *Facility of percolation and freedom of movement of water* from one place to another in a soil.

(d) *Capillarity*—or ability to draw up water from the lower to the upper layer where water is being removed by evaporaton from the soil and from plants growng in it.

(e) *Retentivity*—or power to hold water as surface films round the particles. This is decided chiefly by the size of the particles of which the soil is composed.

A sandy soil, for instance, consists of relatively large particles loosely arranged. The pore space is comparatvely great and, therefore, sandy soil can store, when waterlogged, considerable quantities of water. The soil is also very porous, and rain can soak into it very readily, and can also percolate rapidly both vertically and laterally. The capillarity of sandy soil, however, is very low, for water will not rise very far in it, although it rises rapidly over any distance through which it is able to rise. Finally, sandy soil is not very retentive of water, since the extent of the films which occur round each particle of the soil when properly drained is not very great, the particles being large, and having a relatively small area of surface.

A clay soil, on the other hand consists of relatively small particles, closely packed. It possesses high water capacity, is not very porous, takes a long time to become wetted, and transmits water slowly. It is also very retentive of moisture and therefore dries slowly.

These facts make it clear that a soil which is neither too sandy nor too clayey is the best soil for the majority of plants, and it is the aim of agriculturists so to alter or modify the physical properties of soils by tillage, drainage and manuring, that they will present the best conditions possible for the successful growth of the plants they cultivate.

In Barbados, the soil of sugar estates is ploughed, forked and hoed so as to break it up and to improve (amongst other things) its physical properties. In the waste lands, the tilth of the soil is poor, and such lands, therefore, suffer more quickly from drought than do the prepared cane lands. On the sea shore, (es-

pecially, where the soil consists of almost pure sand piled up in heaps as it is in the sand-dune districts), the physical properties of the substratum are such that the water supply is extremely scanty, and only certain very specialized plants can grow at all in these regions. When the plant associations of sandy beaches and of sand dunes of Barbados are considered in detail, a fuller account of the exacting conditions of plant growth occurring in such habitats will be given.

The ultimate *mode of occurrence* of water in a substratum is of great importance in connection with vegetative activity. Considering a simple case, such as a deep layer of soil of good tilth overlying an impervious bed of some such material as clay, it is to be noticed that any water which gains access to that soil, (whether it falls directly on it as rain or whether it accumulates in it by underground movement or "seepage"), percolates down to the impervious base and then starts to saturate the lower layers of the soil. The level to which the zone of saturation eventually rises is called the "water table." It fluctuates very much according to the seasons of the year and according to the rate at which the ground water is removed by plants or by leakage. Water sometimes ascends by capillarity from the level of the water table to the upper layers of the soil in which the majority of the plant roots are embedded. Capillarity (as has already been stated) is a property possessed by soils to different degrees. It depends on the texture of the soil ; fine-grained soils showing greater capillarity than coarse-grained soils. Whereas the soil below the water table is waterlogged and contains no air, the soil above it, although plentifully supplied with moisture, contains air in its pore spaces, the water existing only as films round the soil particles.

The depth of the water table has great significance in connection with plant growth. It affects two things,—air supply and root room. Let us consider the question in connection with deep layers of soil in which the water table stands at different levels below the ground surface.

2. *Air Supply of a Soil.*

Certain plants cannot live in soil in which the water table is very high, for such a soil practically constitutes a marsh. Air is absent from it, and plant roots must have air in order for them to remain healthy and to produce their root hairs. When the water table is at a higher level than the ground level, water accumulates as ponds. In ponds, only certain very specialised plants can grow, because the air supply is in the form of dissolved gas. Finally, certain plants cannot live in soil whose water table is a long way below the surface, even though the air supply is good. Their roots cannot penetrate down to the moist regions, and they may suffer considerably from drought.

3. *Root Room.*

The extent of the root systems of different plants vary in great degree. Plants of the Monocotyledons (consisting chiefly of grasses) have fibrous roots which ramify in the upper layers of soil chiefly, whereas Dicotyledonous plants (including almost all the common trees and shrubs of Barbados) possess root systems which consist of a central deep-growing axis or "tap-root" which bears numerous side branches. The root systems of many grassy plants require therefore only shallow soil, whereas those of the majority of trees and shrubs can

grow successfully only in deep soil. Water attracts roots towards it, and hence the presence of a well-marked water table low down in a good deep soil results in the production of long and profusely-branched tap root systems, by those plants which are able to produce them.

In a soil where the water table is high, or where the impenetrable subsoil or solid rock is at only a small distance below the ground level, plants which normally produce long tap root systems will be unable to produce them here. Unless those plants can adapt themselves to the new conditions, they will not be able to succeed in a soil of small root room and they will be ousted by plants more fitted for life under the prevailing circumstances. Thus the root room of a substratum has important bearing on the nature of the vegetation that is able to grow successfully in that substratum.

Many of the above results in connection with the effect of the depth of the water table on the growth and distribution of plants are demonstrated to a more or less striking degree in Barbados. The complications which the presence of the fairly porous but slowly absorptive coral rock beneath the soil in most parts of the Island involve, are difficult to estimate, especially since few definite data (such as those obtained by boring or digging) are available. If one assumes that the coral rock is permanently saturated with water, that is, never loses sufficient water even in severe and prolonged periods of drought seriously to reduce its store of water, then the water table problem of the soils of most districts becomes simplified. A definite water table most certainly exists in many sugar estates during all but the very driest of weather. In several regions near the coast, (especially on sandy beaches) its depth below the ground can easily be found by digging a hole and waiting until water collects in it to a stationary level. Very striking relationships between the plant population and the depth of the water table can be established by an investigation of the problem in certain localities near the coast in Barbados. One such investigation is to be described in another place, and there is reason to believe that the study of carefully selected areas in the Island (such as, for instance, Belle Plaine) along these lines would produce very interesting and instructive results. At least they would indicate the importance of the question of the mode of occurrence of water in certain types of substrata, and would explain many observed facts in connection with plant life as it occurs either under natural or under artificial (agricultural) conditions.

4. *Temperature of the Soil.*

The importance of the range of atmospheric temperature has already been discussed. It remains to note now the effect of *soil* temperature on plants and to decide to what causes soil temperatures, (differing sometimes markedly from the average air temperatures near the soil) are due.

The activity of the processes which go on in roots is decided actually by soil temperatures and not by air temperatures. Water absorption is influenced directly by temperature, for the higher the temperature the more rapidly does absorption proceed. Further, for root growth to go on, the soil surrounding the roots must always be above a certain temperature, the average value of which is about 4° Centigrade.

In the tropics, the question of soil temperature is not so important as in other regions, since the air temperature there never falls so low as seriously to affect that of the soil. In many polar regions, were it not for the fact that the soil is at a temperature of a few degrees above that of the surrounding air, no vegetation would grow at all. In temperate countries soil temperature in properly cultivated ground makes it possible for seeds to germinate in comparatively cold weather, and thus to influence considerably the period of vegetative activity, so that "warm" soils produce early crops.

The chief factor that influences soil temperature is undoubtedly the amount of water in the soil, because heat is used up in the warming and evaporation of the soil-water. Wet soils are "cold," that is, their temperature is below that of the surrounding air. Naturally, therefore, those factors that tend to increase evaporation, (such as wind) cause a lowering of the soil temperature, and *vice versa.* Further, much more heat is required to warm up wet soil through a certain temperature-range than is required to warm the same quantity of dry soil or solid rock through the same range.

Another factor that influences soil-temperature causing it to be greater or less than the temperature of the surrounding air, is the colour of the soil, for dark coloured soils absorb the sun's heat more rapidly than do soils of a lighter colour, and at night dark soils lose their heat more rapidly than do light coloured soils.

In Barbados the temperature of cultivated soils is not much different from that of the air. There are few "wet" soils in the Island, and "cold" soils are rare. But rocky districts occur in many places, and here the temperature of the substratum may rise so high during the day time that plant life may thereby be considerably affected. Sandy soils, too, suffer in the same way, and the soil temperature factor is one which must not be ignored in investigating the flora of such regions as dry sandy beaches and coastal dunes.

5. *Nutrients in Soil.*

A typical surface soil consists of three distinct parts, (a) solid inorganic or mineral particles; (b) solid organic particles and (c) soil water,—which contains nutrient salts in solution.

The inorganic part of a soil has been derived from rocks, and the organic part from decayed vegetation. It is not intended to give here a full account of the way in which rock becomes transformed into typical soil, nor of the nature of the chemical changes that go in this process which results in the gradual production of soluble salts. Full details may be obtained from books on Agricultural Chemistry, such as those named in the Bibliography at the end of this book. Suffice it to state that all green plants require certain chemical elements (combined together in such substances as Potassium salts, Calcium salts, Magnesium salts, including Nitrates, Phosphates, and Sulphates, and also in addition traces of Iron compounds) for their successful growth. Most natural soils contain all these essential constituents, but in certain cases the soils are either deficient in one or more of them, or else the compounds are not produced sufficiently rapidly to meet the demands of vigorous and closely growing plants. Hence planters apply manures and till the ground extensively in order to make up for these short-comings in soils in which they intend to grow crops.

As regards the soils of Barbados, it may be remarked that over the larger part of the surface of the Island the soil has been tilled and manured for several generations. After all the natural virgin soil (which was laid bare as the primeval forest was cut down) had been brought under cultivation, the planters had to rejuvenate the land in order to make it continue to produce crops successfully. Hence considerable changes have been brought about in the composition of Barbados soils as a result of the influence of man. This fact must be borne in mind when chemical analyses of typical samples of the soil are scrutinised.

The natural history and the chemical composition of the soils of Barbados have been described by Harrison and Jukes-Brown in their "Geology of Barbados" (1890) Chapter VII. These investigators divide the soils of the Island into "Soils of the Coral Area" and "Soils of the Scotland District." They dwell at some length on the interesting and puzzling problem of the origin and differences between the red and the black soils of the coralline regions of the Island. By a consideration of the chemical composition of these soils, and of the topography and history of the districts in which they are found, they reach the conclusion that the Barbados black soil of the lowland regions has in part been derived from the red soils of the uplands, and has been transported into its present site by the action of running water and by natural gravitation from higher to lower levels. The Scotland District soils include a variety of types, the nature of which indicates the marked relationship between the composition of the underlying rock and the chemical properties of the soils derived from them. The case of the alluvial soils of the valleys and flats in the Scotland District, (consisting as they do of rain-washed materials from the hilly land), exhibit special features by reason of their origin and mode of deposition.

Sufficient evidence as to the composition of the soils of the uncultivated districts of Barbados has not yet been accumulated to throw light on the relation between the quality of the nutrients in these soils and the form of vegetation that occurs on them. One would expect that the soils of most dry pastures and of rocky waste places would prove on examination to be poor in one or other of the essential plant nutrients, judging by the scanty and scrubby vegetation that is found on them, and arguing by the analogy that similar vegetation in other regions of the earth's surface always characterises soil poor in nutrient substances. The case of the substratum on the sea beaches is at first sight fairly easy to imagine. One would not expect to find all the necessary constituents of mineral plant food present in sufficient quantity in such a soil as sea shore sand. Yet many plants grow quite luxuriously in this medium. In fact, experiment and observation show that the nutritive substances indispensable to higher plants occur in nearly all soils, and that only a very small amount of these substances is required by the majority of plants for successful growth.

Note should also be made of the fact that plants can exercise a power of quantitative selection, absorbing the various substances presented in solution to their roots in proportions other than those in which they occur in the substratum. Plants also to a certain limited extent exercise a power of qualitative selection, in that they absorb only certain substances and reject others. For instance, they are unable to absorb water containing a high proportion of common salt. Plants growing in very salty soil then, can obtain only a minimum of water even though the soil appears to be almost saturated with it. Hence those plants which are able to grow successfully in salty soil possess such structural features as enable them

to economise water, and to lose little of it by transpiration (or evaporation from their leaves and stems). They constitute a special class of plants known as "Salt plants" (or Halophytes) of which more will be said later. In many regions near sea coasts the soil is charged with common salt which gains access to the land during periods of tidal flood, or which penetrates into it by seepage from the sea. Such "salt marshes" support a characteristic vegetation of halophytes. In Barbados only a few samples of salt marsh vegetation are to be found at the present day, and although they are not very typical, yet they give some idea of what a true halophytic plant association is like. It is highly probable that salt marshes were very common in certain parts of Barbados in past ages, for indications of their former existence in many places (as for instance, along the southern coast) are still to be seen.

Finally, other chemical compounds such as calcium carbonate (lime), when present in excess in soils are said to act as does common salt. Only plants with certain structural modifications can perhaps tolerate large quantities of lime, and soils which contain, say 3% and upwards of calcium oxide occasionally exhibit the fact by being able only to support plants of a certain kind. In Barbados very few or no cultivated soils contain as much as 3% of calcium oxide (see "Geology of Barbados" Harrison and Jukes-Browne, pp 51 & 55), and the same may perhaps be said of soils of waste places, with the exception of the scanty soil in course of formation on heaps of limestone debris, or on the newly exposed coral rock of quarries and marl pits. One might expect that, since the rocks in the Scotland District are of different chemical composition from the coral rock of the rest of Barbados, the plants of that district would show marked differences from those of the coralline regions. This appears on investigation not to be so, the reason being that no definite inference can be drawn from the fact that because a rock mass is composed chiefly of calcium carbonate the soil derived from it will possess an abnormal percentage of lime. Chemical analysis shows the fallacy of this tempting conclusion, and illustrates the need for caution in coming to hasty decisions in such intricate considerations as the relation between rocks and soils.

CHAPTER VI.

BIOLOGICAL FACTORS.

Of biological factors, the influence of man is by far the most important and profound. In order thoroughly to understand how far man has affected the vegetation of Barbados, it would be well to consider first the past history of the Island.

Barbados was first colonised by civilised man in 1625, when a party of some forty Englishmen landed on the Leeward coast. According to Ligon who visited the Island in 1647, Barbados was at first overgrown with forests and thickets, and the early settlers had great difficulty in planting crops, so massive and close growing were the trees. The Civil Wars in England caused many more colonists to seek homes in Barbados. In 1676, over 2,000 whites and 32,000 negroes were living there. Deforestation went on at a rapid rate from this time, the process being greatly accelerated, by the increase in the cultivation of sugar cane which had been commenced in Barbados in 1640 or thereabouts. Many of the trees were cut up and shipped away. Fustic, Logwood, Lignum Vitae and West Indian Cedar were the chief timbers exported. Large quantities of wood were used as fuel in sugar manufacture, and houses and estate buildings were erected out of felled trees of such species as Locust, Mastic, Bullet Tree, Red Wood (or Sea Grape) and Yellow Wood (Zanthoxylum). During these early days, many plants were introduced into the Island either to be grown as fodder or to be cultivated as crops. Records indicate that Maize, Sweet potato, Yam, Cassava, Plantain, Banana, Ginger, Bonavist, Tobacco, Aloes and Sugar-Cane were introduced for one or other of these purposes soon after the date of settlement, while Cotton and Indigo, which were found growing wild in the Island, were also cultivated for export. Later, many other plants were brought to Barbados from different parts of the world. Many of these are nowadays very common in the Island, so much so that most people imagine that they are native plants of Barbados and belonged to its aboriginal flora. Mahogany, Tamarind, Evergreen, Woman's Tongue, Barbados Almond, Flamboyante, Frangipani, Mango, Orange, Lime and most ornamental garden shrubs and herbs are introduced plants, as are also several weeds and uncultivated shrubs and herbs which have become so well established that they even enter into the natural plant associations in the different regions of the Island.

In very few places only are the relics of the ancient forests of Barbados nowadays to be seen. The best impression of their botanical characters is furnished by Turner's Hall Wood in the Scotland District. This area will be described in a subsequent chapter. The only other remaining region of primitive forest land in the Island is Foster Hall Wood situated under the brow of Hackleton's Cliff. In certain gullies, the vegetation is probably similar to what it was in the early days, but gullies have received attention from man, and in many cases have suffered somewhat from his interference. Nevertheless, a study of the vegetation of gullies will help to convey some general idea of the nature of the primeval flora of Barbados.

Man has completely altered the face of the country in all parts of the Island, and he still continues to alter it in small degree by his conscious or

unconscious interference with its vegetation. He cultivates the soil and grows crops for pecuniary gain and for his own use. On the cultivated land certain weeds to a limited extent are, however, able to flourish. Waysides, ditches and a few ponds owe their existence to man's activity, and although the majority of plants growing in these habitats are self sown, yet many of them probably belong to the primeval vegetation and have taken refuge there. Hence in seeking to understand the reasons for the distribution of plants in Barbados, man's influence has to be considered as a very important factor. In a few regions in Barbados is man's influence not felt. Such places, however, as sea beaches, rocky places, certain of the deeper gullies, and cliff faces, owing to the poorness of soil, exposure to wind, lack of moisture or inaccessibility, are quite unsuitable for cultivation, and have therefore received little direct interference from him.

Even in these places, as well as in many pastures and along waysides, animals such as goats and sheep, for whose introduction into the Island man is primarily responsible, considerably influence the vegetation by their grazing. They prevent trees from growing up and converting certain districts into forest land again, and incidentally, they unconsciously bring about the dissemination of many plants whose fruits or seeds adhere to their bodies.

THE RELATIVE IMPORTANCE OF THE VARIOUS FACTORS WHICH HAVE INFLUENCED THE DISTRIBUTION OF PLANTS IN BARBADOS.

In discussing the reasons why the present day plant population of Barbados (including as it does both cultivated and wild plants) comes to consist of particular kinds and assortments of plants which constitute it, one must constantly bear in mind that the nature of the Barbados flora prior to the advent of man on the Island was very different from what it is to-day.

The composition of the aboriginal flora, and the distribution and grouping of the species of plants which comprised it, was undoubtedly determined by the important factors—climatic, topographical and soil factors—just as the flora of any other land area is determined by these factors when once it becomes colonised by plants. It is not intended to discuss in this place what were the natural means whereby Barbados originally became colonised by plants, as the question is to be considered in the last part of this book.

It is almost certain that the aboriginal flora of Barbados was fairly uniform in type throughout the whole extent of the Island, and that rainfall was the chief factor instrumental in fixing its general composition as the flora of an area within the tropical American Zone. Probably the flora of Barbados always did differ in marked degree from that of the more rainy islands of the West Indies, and from that of the South American continent. The surface configuration of Barbados has probably never been sufficiently varied for topographical factors other than those having a direct bearing on rainfall to have had much effect on the aboriginal flora; nor were variations in the soil conditions of the Island in the early days probably sufficiently well marked to have influenced to any appreciable extent the distribution of the plants which composed the primeval vegetation.

When man commenced his activities in Barbados, no doubt he quickly upset the balance which had probably been set up within the plant associations that made up its primitive flora. Firstly, his removing the larger trees would cause

a lowering of the rainfall, and would also open up the land to the direct action of wind and sun, so that the undergrowth once protected, would now suffer considerably through the absence of shelter. Tillage of certain parts of the land next would expel many low-growing plants which would thereafter be able to live only in those places where tillage operations were not performed. Following the spread of plant cultivation by man, the soil conditions in different parts of Barbados, would naturally be profoundly altered. Eventually the factors connected with the topographical irregularities of the land-surface, and with the nature of the soil in the various parts of the Island, would begin more effectively to operate, and the re-association of plants to suit the new conditions of growth would be initiated.

When new plants were imported into the Island by the early settlers, another disturbing factor of great moment was introduced either consciously or unconsciously. Many of the imported plants have escaped from direct control so that they now enter into the composition of certain natural plant associations. Thus we should be safe in saying that the most important factor which has been instrumental in bringing about in the flora of Barbados the profound changes which have gone on since man first started his activities in the Island, is the factor which man's presence has itself introduced.

PART II.

THE PLANTS OF BARBADOS.

CHAPTER VII.

CLASSIFICATION OF THE VEGETATION OF BARBADOS.

The present-day vegetation of Barbados may be divided into two more or less distinct classes according to the degree in which their distribution and mode of occurrence have been influenced by man. The first division includes those plants that are found grouped together in *natural plant communities* and which have come to be so arranged chiefly as the result of the "sifting effect" of agents such as the climatic, topographical and soil factors described in the last part. The plant communities implied by this statement occur in districts where man's influence has not, to any appreciable extent, been felt. It is worthy of note that a number of the plants forming these natural communities are introduced plants, that is, they have been brought into the Island, consciously or unconsciously, by man. They are, nevertheless, perfectly established in the different plant communities, (probably by reason of the remoteness of their date of importation), and do not materially alter the general nature of the question of distribution. Wherever an introduced plant is mentioned in a subsequent description of a region of vegetation, a statement of the fact will be made, so that the truth of the above remarks may be tested.

In Barbados, the districts in which the plant population consists of a natural plant community are of small area but are nevertheless of varied nature. Examples of them may be found in rocky shore districts, rocky waste places, gullies, certain waysides and perhaps ponds. If the plant communities of such regions as these be examined in turn, it will be noticed that in certain cases the community is made up of plants of one general type, whereas in other cases, it may consist of two or more types intermixed. In other words, the plant community may consist of one or of more than one "pure" plant association. Take as an instance almost any example of the rocky waste places that occur on many estates in the upland parts of Barbados. It will be found that a certain set of plants grows on the bare rock itself (being rooted in the crevices and channels in the rock), while another set of plants grows in the shallow soil which occurs between the rocks or in pockets and hollows in their surfaces. The plants of the first set are erect, scrubby plants, able to live even under the severe dry conditions of their rocky habitat, whereas those of the second set are small pros-

trate herbs which are able to thrive only where a certain amount of soil covers the rocky substratum. We have here, then, two "pure" plant associations inhabiting different sub-regions of rocky waste land, and we may term the vegetation of such a district a "mixed" vegetation consisting of two pure plant associations.

It is therefore proposed to deal with the plants of Barbados which are grouped together in undisturbed regions, under the headings "Pure Plant Associations" and "Mixed Plant Communities." Typical districts where a single "pure" association occurs will, as far as possible, be chosen and described, so that the features of the plants established under one set of growth conditions may be learned, and the relation between these features and the factors at work in the environment may be understood.

The second division of Barbados plants includes those plants that are found either only occasionally in groups, or in entirely isolated positions, and whose arrangement and mode of occurrence are, to a greater or lesser degree, due to man's influence in so far as he has unconsciously or consciously determined the nature of the environment in which the plants are now found to be living. Here again these plants may be subdivided into several groups as the following statement will indicate. Consider as an example the weed vegetation of a cane-field. As will be pointed out in detail in another chapter, this consists of certain plants which are able to persist in spite of the operations of tilling and weeding, and in spite of the fact that the sugar cane plants themselves exert some influence on other plants growing in their vicinity. Cane field weed vegetation, therefore, constitutes an association of plants whose nature has been decided in part by the unconscious influence of human agency. Next consider the case of the plants that populate many roadside gutters or trenches. These plants live in a habitat whose features have been partly decided by man. The depth of the soil, the liability of that soil to receive much or little water during rainy weather, and so on, are all decided, again unconsciously, by man. Further, the regularly repeated operation of weeding or cleaning roadside gutters restricts the growth of certain kinds of plants which will therefore never characterise such a habitat. The plants of cane fields and of certain roadsides may be consequently grouped together as associations of plants which owe certain of their features to human influence. They may be termed "artificial plant associations."

Finally, there are, in Barbados, plants such as shade trees, fruit trees and ornamental trees, which grow in habitats more or less suited to them, but often decided by man, who establishes specimens of these trees wheresoever he desires. Occasionally these plants may be self-sown and may become fixed eventually as regular members of some plant association, but such occurrences are rare. Plants cultivated for food and plants grown in gardens for their beauty of flower or form, are other examples of plants which occur in habitats decided for them by man. According to the peculiar features exhibited by the plant population of Barbados it would be advisable, for the sake of clearness and in order to avoid a possible misunderstanding of the nature of the botanical problems presented by the flora of the Island, to adopt some such classification as that outlined above.

In order to make clear the relationships between the various classes of plants it would also be advisable to tabulate the classes before proceeding to a consideration of each in turn.

DIVISION A. *Plants of Natural Plant-Communities whose features have been little influenced directly by man.*

(I) *Pure Plant-Associations.*

(II) *Mixed Plant-Communities* (consisting of two or more "pure" associations).

DIVISION B. *Plants whose distribution, arrangement or mode of occurrence have been largely influenced by man.*

(I) *"Artificial" Plant Associations.*

(II) *Plants occurring in no ecological grouping* (including Trees which occur in more or less isolated situations, cultivated Crops and Garden Plants).

DIVISION A.—THE NATURAL PLANT COMMUNITIES OF BARBADOS.

SECTION I. THE PURE PLANT ASSOCIATIONS.

CHAPTER VIII.

CLASSIFICATION OF THE PURE PLANT ASSOCIATIONS.

In this section it is intended to deal with several well-defined plant associations which are to be found occupying certain regions of Barbados in each of which the conditions governing the growth of plants are more or less uniform. Although the actual area occupied by the plants of pure associations in the Island is small (being about 1/6 of the total area), yet there occur in it districts where one or other of the pure plant associations are sufficiently typical that an observant student is easily able to obtain first-hand knowledge of some of the fundamental principles of Ecological Botany by a careful investigation of them.

In attempting to classify plant associations according to the relations between the botanical features and the conditions of growth in the environment, one recalls to mind at the very outset the fact that certain plants are able to grow in water and others on land. This at once suggests a division of plant-types into aquatic and terrestrial. At the same time, it hints at the importance of water as a decisive factor in determining the limits of plant associations, and causes one to enquire closely into the effect of the different soil factors on the distribution of plants within a particular climatic vegetation zone. Careful investigations have shown that *the influence of soil factors in determining the development of definite natural plant communities over a limited area is undoubtedly of major importance, and that of* all *the natural factors which act within the soil, the factor of water supply is the most potent.*

In spite of the great difficulty in arranging plant-associations into comprehensive groups (chiefly by reason of our lack of detailed knowledge of the relative importance of soil factors), it is generally agreed that the simplest and most satisfactory grouping is that based on the *water relation* of plants. According to this commonly accepted scheme, plants are divided into Hydrophytes, Mesophytes and Xerophytes.

(I.) HYDROPHYTES. This name means "*Water Plants.*" Plants of this ecological division grow in situations in which the water supply is extremely abundant. They may live totally submerged in water or in soil which is very wet.

Sub-divisions.

(A) *TRUE HYDROPHYTES.* These plants live under conditions very favourable to vegetative activity. The water in their habitat is not saline to such an extent that absorption by their roots

is prohibited, nor is its temperature too low effectively to minimise absorption.

The sub-division includes the following plant associations.

(1) *Free-swimming or free-floating hydrophytes.*

(2) *Anchored hydrophytes.*

(3) *Swamp hydrophytes of pond margins, &c.*

(B) *XEROPHYTIC HYDROPHYTES.* These plants live under conditions generally unfavourable to vegetative activity. Although abundant water occurs in their habitat, yet it contains such a high percentage of dissolved salts, or its temperature is so low, that water absorption is checked, and the plants succeed only by being so constructed that loss of water by transpiration is almost a minimum.

The sub-division includes in Barbados the following plant associations:—

(1) *Sedge-swamp plants* (Sedges, &c.)

(2) *Mangrove-swamp plants.*

(II.) MESOPHYTES. This name means "Middle Plants." Plants of this division live under medium conditions of water supply. They include the majority of plants, and they show every gradation between Hydrophytes on the one hand and Xerophytes on the other.

Sub-divisions—The following are the chief Mesophytic plant-associations of Barbados:—

(A) *MESOPHYTES OF GULLIES.* These plants live under various conditions of soil, such as are naturally presented by the different regions of a gully floor. They include herbs, shrubs and trees.

(B) *GRASS AND HERB MESOPHYTES OF DRY PASTURES.* (Grasses are botanically speaking herbs, but it is convenient to distinguish between grassy plants and the common herb forms on the grounds of their general differences in vegetative habit).

(C) *WOODY MESOPHYTES OF THE FORESTS.*

(III) XEROPHYTES. This name means "drought plants." Plants of this division are exposed to dry soil and dry atmosphere.

Sub-divisions.

(A) *PSAMMOPHYTES* or sand plants. These plants live on a sandy substratum in which the water supply is very scanty owing chiefly to the physical properties of the medium in which they grow.

The sub-division includes in Barbados the following plant associations:—

(1) *Beach plants.*

(2) *Sand-dune plants.*

(3) *Sandy-field plants.*

(4) *Sandy-bushland plants.*

(B) *LITHOPHYTES* or "rock plants." These plants live on exposed rock surfaces where soil is very scanty or altogether absent.

The sub-division includes in Barbados the following plant associations:—

(1) *Plants of sea-cliffs.* (Sea-cliff Halophytes).

(2) *Plants of rocky land.*

(3) *Plants of vertical rocky walls.* (Such as occur in gullies in Barbados).

It is proposed to consider first the Xerophytic plant associations of Barbados. The vegetation of a district where the particular association is best developed will be described, prefaced by notes on the peculiar conditions of the habitat in which that vegetation is growing. Examples of plants most characteristic of the association will then be given, with a short description of certain of them.

CHAPTER IX.

THE XEROPHYTE ASSOCIATIONS OF BARBADOS.

(A) **PSAMMOPHYTES** (or Sand Plants).

(1) **BEACH PLANTS**

The locality chosen to illustrate the chief features of a Barbados sandy-beach pure plant association is situated on Maxwell coast in the south of the Island between the spit of sand to the east of Calais and Nova Lisboa. Its length, measured along the curving sea margin, is about 500 yards, and its width measured from the high water mark to the zone of artificially planted trees bordering its landward side, is about 150 yards. This strip of coastland is comparatively newly formed. Up to about thirteen years ago there was little or no beach here at all. Nowadays the sea never encroaches on the land, the surface of the ground being on the average some four feet above sea level, and rising to this height quickly from high water mark.

Along the sea border between the tide marks (which are here about ten yards apart), there is no sign of active vegetation, but only sea weeds littered here and there in varying stages of decay. Sea weeds, with few exceptions, require a fixed substratum, and this is not to be found in the moving sand of a wave-washed beach. At very low tide however, rocks are exposed below the low tide mark in this district, and these rocks are found to be covered by sea weeds of many forms and colours. The sea weeds constitute a Marine Hydrophyte Association and differ widely from land plants in their characters of outline, of function and of propagation. They belong to a botanical class of plants known as Algae, and will be described in more detail when the Hydrophyte plant associatons are considered. Turning our attention to the belt of sand which forms the main part of the area, we find here a plant association of a very distinctive type, growing in a substratum in which little or no organic matter is present. The water supply of the plants is mainly that which is brought up from the lower layers of saturated sand by capillary attraction. If one digs a hole anywhere in this region, one eventually comes down to the moist under layers, and if the hole be sufficiently deep, water will ooze into it and will in time attain a constant level which corresponds to the level of saturation or "water table" in the sandy substratum.

Excavations made in this way in early May 1917, towards the end of a continuously dry period of about two months duration, gave the following results:—

	Distance of hole from high water mark	Depth of "water table" below *ground* level	Depth of "water table" below *sea* level
1	8 yards	2½ feet	½ foot
2	50 „	5½ „	2½ feet
3	150 „	6½ „	2 „

The measurements are approximate only, for the sandy ground is very uneven. The results indicate that the maximum depth of the water table below ground level in this region is about 5 feet. In the wet season the level of the water table is perhaps somewhat nearer the ground surface, but no actual measurements are on record.

The water which collects in holes made in the sand is remarkably pure. At the time when the observations were made, samples of soil water were taken, and their salinities estimated. The following results were obtained:—

Distance of hole from high water mark.	Parts by weight of dissolved substances per 100,000 parts by weight of water.	Percentage of organic matter in the dissolved substances.
50 yards	48 parts	none
150 „	24 „	trace
For comparison		
Sea water	4,355 parts	none

It is quite clear that the limiting factor governing the growth of plants in the habitat under consideration is the availability of water at the roots of the plants. The material of which the substratum is composed is coarse, loose, white, coral sand. Its texture is such that it is very porous, almost non-retentive of water and of low capillarity. It is, therefore, "warm" and dry, and the movement of water from the moist lower layers is slow and its amount almost negligible, the topmost layer of all being especially devoid of water.

The means by which the under layers of the substratum become charged with water are of two kinds. First, rain falls on the land in the wet months of the year and is absorbed by the porous sand. Much of it undoubtedly gets away to the sea by underground lateral movement, but the lower layers of sand, along with the underlying coral rock, probably permanently retain some of the rain water. Secondly, water reaches the substratum by seepage from the inland line of limestone cliffs which borders the district to the north. The most conspicuous line of cliffs lies at a distance of about ¾ mile from the sea coast, and is of average height 40 feet. From the base of the cliffs, the land extends seawards in a flat cultivated expanse until it reaches a low ledge of rock of height about 6 feet, which immediately borders the sandy tract. Undoubtedly the porous coral rock of which the terraces ending at the two cliffs faces (the first of considerable height and the second, low) are composed, stores up a considerable amount of water in the wet season and lets it out again gradually, as a series of underground springs and as seepage water, into the low-lying sandy beach. That such a letting out of

water from inland cliffs of this sort is continuously going on here and in other localities in Barbados, is indicated by the presence of springs of fresh water in many places along the coast of the coralline region of the Island. These springs frequently rise upwards out of the sand just below low water mark and are of sufficient magnitude to cause the water near the land to be cool and of small salinity. A typical example occurs at Freshwater Bay.

From the above account it will be gathered that any plants which manage to thrive in the habitat presented by a sandy beach live under conditions of severe drought and of intense light. We should therefore expect that their characteristics suit them to live under such conditions, and it would be best to study at once the flora of the beach in order to find out what are the xerophytic features of sand plants of sea beaches.

Our first observation of the nature of the vegetation of the district under consideration is that it is by no means dense. It is an open association. Secondly, the plants themselves are chiefly low creeping herbs, or small erect herbs and shrubs. A few fairly tall shrubs or bushes occur scattered about, especially in the region of the beach most remote from the sea. The creeping plants consist exclusively of the conspicuous Goat's-foot Ipomaea (*Ipomaea biloba*) and the stout- stemmed Binding Grass (*Paspalum distichum*). The erect herbs include the milky, small-leaved Seaside Spurge (*Euphorbia buxifolia*); a grass-like tufted plant (*Mariscus brizeus*); and a tufted grass (*Paspalum sp. (? caespitosum)*. The shrub which occurs in conspicuous grey clumps of all sizes in every part of the area is the Seaside Lavender or Crab Bush (*Tournefortia gnaphalodes*). It is a typical sea-beach plant and is worthy of special study. Of the shrubs that occur here and there in the hinder parts of the sandy region, the common Sea Grape (*Coccoloba uvifera*); the Horse Nicker (*Guilandina bonducella*); the Spanish Needle (*Yucca aloifolia*); and a few specimens of the Maypole Bush (*Agave americana*) are the only plants of importance. It is not certain, however, whether or no the two last-named plants belong to the natural vegetation of the region, for many individuals of these species have been planted artificially from time to time in order to reclaim the sandy land as it was forsaken by the sea. There is one shrubby plant whose presence in the back part of the sandy zone is perhaps due to natural causes; it is the common pink flowered Sage (*Lantana involucrata*), especially abundant in rocky districts of Barbados. This plant will be described when the vegetation of such rocky districts is considered. Finally, many rather stunted specimens of the blue flowered Vervain (*Stachytarpheta indica*) occur in the more inland parts of the sandy zone. The Vervain is a very common plant in other more favourable habitats in Barbados, and will be described elsewhere.

DESCRIPTION OF THE MORE COMMON AND TYPICAL SANDY-BEACH PLANTS.

1. *Tournefortia gnaphalodes.* (Boraginaceae) Seaside Lavender

An erect shrubby plant of height up to 3 feet. The much-branched lower parts of the plant possess black, shiny bark, but the young twigs the leaves and the inflorescence-stalks are covered with a fine silvery down. The leaves are about 2 inches long, and narrow. They are stalkless and are arranged in close bunches at the ends of the twigs. They lose a minimum of water by transpiration, chiefly by reason of the protecting effect of the covering hairs. Water is stored up in the

succulent tissues of the slightly fleshy leaf, this feature, as well as the presence of the hairs, being a typical xerophytic adaptation. The root system of the plant is extensive. The flowers and fruits are arranged in a "one sided cyme."

2. *Ipomaea biloba* (*pes-caprae*) (Convolvulaceae) Goat's-foot Ipomaea.
A perennial creeping plant with very long, thick, herbaceous trailing stems, which are attached here and there to the sand by long slender roots which spring from the places where the leaves are attached (i.e. from the nodes). The herbaceous stems are usually joined on to a thick stout root-stock, which is very deep-growing and much-branched. By reason of this the plant is able to obtain water from the moist under layers of the substratum when once it is established. This fact accounts for the luxuriance of growth and fresh greenness of appearance of Goat's-Foot. The leaves are shiny, leathery, and shaped like the base of a cloven hoof. Their structure (especially the presence of a resistant water-proofing shiny layer of cuticle on both surfaces) is such that the plant loses litte water by transpiration, so that no waste is made of the water absorbed. This feature enables the young plants (which take in water only by their fibrous roots attached to the stem) to thrive in the loose sand until the root stock develops. The flower of the Goat's foot is bell-shaped and of a purplish colour. The fruit is a brittle capsule which contains usually four smooth seeds.

3. *Euphorbia buxifolia* (Euphorbiaceae) Seaside Spurge.
An erect, shrubby plant of height about 2 feet. The leaves are small (which reduces the surface area from which water may be lost by transpiration). They lie close to one another and to the stem which shades them somewhat from direct sunlight. They possess smooth, thick, waxy skins and contain a milky juice. This juice is harder to evaporate than pure water, and may be considered as a special xerophytic feature of the plant. The tiny inconspicuous flowers and small spherical capsules are borne in large numbers in the leaf axils on the upper parts of the branches.

4. *Mariscus brizaeus* (*Cyperus ottonis*) (Cyperaceae) Sand Sedge.
A perennial, grass-like, tufted plant with long, narrow, stiff, rough leaves. These often grow to a length of 2 or 3 feet. A long, stout, green, central stalk bears brown clusters of minute flowers which occur in the axils of 3 or more long, horizontal, leaf-like bracts.

5. *Paspalum distichum* (Binding Grass)
Described under Sand dune plants.

6. *Coccoloba uvifera* (Seaside Grape or Sea-grape)
Described under Sand dune plants.

7. *Lantana involucrata* (White Sage).
Described under Rock plants.

(2) SAND-DUNE PLANTS

The most perfect development of a sand dune plant association in Barbados is to be found near Long Pond (Belle Plaine) in the Scotland District. This will be taken as a type-example therefore, and will be described in some detail. At Belle Plaine (as the alluvial flat over which flow the two chief watercourses of the Scotland District is called), the rivers unite and flow seawards at a point near St. Andrew's Church. The water does not here enter the sea by any definite estuary, but in consequence of the waves having thrown up a barrier of sand across the mouth of the water course, the river bends round and forms an elongated expanse of water (called Long Pond), which runs parallel to the shore and at no great distance from the sea margin. It is near Long Pond that the sand-dunes occur. These dunes extend for a distance of one mile north of the pond and also form several low ridges between it and the river. They have been formed by the accumulation of wind-blown material transported from the sea-shore, which constantly receives large deposits of sand by reason of the peculiar inwash of the currents along the coast of this part of the Island. The sand of the beach and of the dunes of the Scotland District differs from the sand of the beaches of other regions of Barbados in that it is composed chiefly of siliceous and not of calcareous material. It resembles calcareous sand, however, in the comparatively large size of the individual grains of which it is constituted.

Let us now consider the sand-dunes of the Long Pond district in connection with the plant population which they support. Nearest the sea, the dunes are small and but sparsely covered with vegetation. They are typical "white dunes", and their initiation may be seen going on in those places where tufts of shore plants have arrested the onward motion of the wind-blown sand. The chief plants which play the part of obstacles in this connection are the Binding Grass and the Seaside Spurge. The former possesses long profusely-branched stems, which run over the sand or just below its surface, and spread often almost down to the high water mark. The stems frequently become buried by the loose sand, and thus take on the characteristics of persistent underground stems or rhizomes. They give rise at intervals to upward growing shoots which protrude above the level of the substratum, the line of the underground parts being marked out by the rows of subaerial shoots springing from them. The numerous and exceedingly long roots of the plant permeate the loose sand in abundance and bind its grains together. The shoots possess the remarkable power of growing upwards through any loose sand that collects round them. This faculty of enduring temporary burial is the chief characteristic of the Binding Grass which renders it such an efficient dune builder. In the interior of the old dunes broken down by wind or other means, one finds a great number of old rhizomes and roots of this plant, which thus indicate the important part played by the grass in accumulating fresh stores of sand. The Seaside Spurge (which has already been described) is able to colonise bare and shifting sand, probably by reason of the quick growth and deeply rooting habit of its seedlings. Small tufts of this plant occupy isolated positions often quite close to the sea margin. They are capable of quick growth, so that, to a limited extent, they can keep their leafy shoot-tips above the surface of the sand, and thus, like the Binding Grass, materially aid in the building up of the dunes. After the dunes have reached the height of a few feet, however, the Spurge plants usually end by being buried, but fresh individuals may be established on the surface of the sand heap, and so the process of accumulation may go on.

Once the dunes have been started and the mobility of the sand destroyed, it is a comparatively easy matter for certain other plants to gain a foothold on the substratum. On the Long Pond dunes the Goat's-Foot Ipomaea is the most conspicuous of such plants. Its long trailing stems are to be seen on the "fixed" dunes forming often a close network held down firmly to the sand by the long fibrous roots. An unidentified grass which possesses short, flattened, broad leaves arranged alternately at angles to the stem axis, and whose long stems trail over (and not through) the sand, is also a very common sand binder, its roots penetrating the substratum to a great depth. Occasionally on the lower slopes of the dunes (especially on their seaward sides where salty water saturates the sand), certain true succulent halophytes occur. The Seaside Samphire (*Sesuvium*) , and a species of *Iresine* (to be described as rock halophytes in a later chapter), are the most common plants of this type, often occurring in abundance on or near the sand-dunes. Another plant which is to some extent succulent is the Wild Lavender (*Heliotropium curassavicum*), whose small waxy leaves exhibit a blue sheen when the full sunlight shines on them.

The older and larger fixed dunes support a vegetation which is chiefly grassy. The sandy surface becomes covered by a sod consisting of low prostrate herbs, which, on decay, enrich the substratum in humus and thus gradually make the conditions more favourable for plant growth. Dunes clothed with vegetation of this sort show no white, sandy, bare patches, and are therefore termed "grey dunes". The plants of the grey dunes of the Long Pond district are chiefly the unidentified flat trailing grass mentioned above, the Egyptian Grass (*Eleusine aegyptiaca*) ; a short, fine, dark, greenish grass (*Eragrostis purshii*) ; the Burr Grass (*Cenchrus echinatus*) ; the Goat's-foot Ipomaea; *Lippia reptans* and the Duck Weed (*Pectis humifusa*) ; the two latter forming mats on the sandy surface.

The Binding Grass and the Spurge are usually absent on the grey dunes. They have succumbed in the end after a long struggle with the conditions of life enforced by the shifting sand, and have prepared the ground for the establishment of other more fixed types of plants whose mode of growth does not fit them for populating a loose and shifting substratum.

On many of the grey dunes, especially on those that occur farthest away from the sea margin, numerous and conspicuous shrubs have become established. Of them the dominant species is the Sea Grape (*Coccoloba uvifera*). The long roots of this plant, in places where part of a dune has been broken away by the undermining action of the river, may be seen to reach right down to the bottom of the dune, and actually to penetrate the surface of the alluvial flat beneath it. The Sea Grape is a typical sand plant, and its seedlings, by reason of their quick-growing tap roots, are able rapidly to establish themselves on any substratum containing a modicum of organic matter and of moisture. Along with the Sea Grape, the striking French Cotton plant (*Calotropis procera*) is of frequent occurrence, and occasionally also, the Manchineel (*Hippomane mancinella*) ; Horse Nicker (*Guilandina bonducella*) ; Seaside Sage (*Croton flavens*), and the Fat Pork (*Chrysobalanus icaco*) .

Behind the dunes, stretches of fixed sand covered by an association of "sandy-field" plants extend inland for a distance of some 300 yards, (especially to the north side of the river), where the ground rises gradually to a ridge of hills of height about 250 feet, which bears a covering of drift sand for almost

half the way up its slopes. To the south of the river, this sandy fiield soon gives place to cultivated land which merges into the cane fields of Belle Plaine.

DESCRIPTION OF THE MORE COMMON AND TYPICAL SAND DUNE PLANTS.

1. *Paspalum distichum* (Gramineae) Binding Grass.
   A perennial grass with long stems which are usually underground and persistent. These underground stems put out vertical leafy shoots at intervals, and are anchored in the sand by long roots. The inflorescence consists of two short broad spikes of tiny flowers, attached in a V shaped fashion to the end of the inflorescence-stalk. The Binding Grass is common in dry pastures, swampy ground, and in other widely-differing habitats. It is sometimes mistaken for the Devil's Grass, especially in those habitats where the underground stems are not typically developed, the plant then taking on the characteristics of a soft, leafy, trailing grass. The leaves of the sandy-beach and dune-form, are tough, and possess a resistant covering layer which enables the plant to resist desiccation.

2. *Lippia reptans* (Verbenaceae). No common name.
   A woody herb with much branched trailing stems closely adpressed to the substratum, and firmly held there by numerous roots which spring out from the nodes (i.e the point of attachment of the leaves). The leaves are small, of a dark greyish green colour and fairly thick, with a slight inclination towards succulence. The leaf surface is protected by a leathery outer layer. The tiny flowers are borne in roundish heads.

3. *Pectis humifusa* (Compositae) Duck Weed.
   A flat growing plant with woody base and very numerous, crowded, small, bright-green leaves. The whole plant forms a plate-like cushion (or "mat") which can be pulled away bodily from the substratum. The mat habit is an important and characteristic feature of plants such as the Duck Weed, for closely-growing leaves pressed tightly on to the surface of the ground keep in the moisture of the upper layers of the substratum, which they protect from the direct rays of the sun. They also save loss of moisture by transpiration because they are spread in the more humid layers of air which occur near the ground surface. Finally, mat plants accumulate humus from their dead leaves and form flat spongy masses which retain water from dew and rain, and also conserve the materials absorbed by the plants during growth.

4. *Coccoloba uvifera* (Polygonaceae) Seaside Grape or Sea Grape.
   This common woody shrub is too well known to require minute description. It exhibits xerophytic characters in the structure of its tough leathery leaves, which are furthermore arranged in two ranks, so that the lowermost leaves on the long straight stems are shaded from the direct rays of the sun by the upper leaves. The flowers of the Sea Grape are borne in racemes, and the fruit is a hard-stoned drupe.

5. *Calotropis procera* (Asclepiadaceae) French Cotton.
An erect woody plant containing a milky juice. The sparsely branched stems (which often reach a height of 6 feet or more) bear flat leaves in two ranks. The leaves are inclined upwards and mutual shading occurs. The leaf surface (and also that of the young stems) are covered with a conspicuous "bloom" of wax. The arrangement of the leaves, the presence of milky juice, and the waxy layer are all xerophytic features which enable the French Cotton to live successfully in a dry sandy substratum. The flowers are of peculiar structure and the fruit is a swollen bladder-like object which encloses numerous neatly packed seeds. The seed is provided with a tuft of long silky hairs by the aid of which it is disseminated by wind on the decay of the fruit.

6. *Sesuvium portulacastrum* (Seaside Samphire)
Described under "Sea Cliff Halophytes"

7. *Iresine portulacoides.*
Described under "Sea Cliff Halophytes"

8. *Heliotropium curassavicum* (Wild Lavender)
Described under "Sea Cliff Halophytes"

9. *Croton flavens* (Seaside Sage)
Described under "Plants of rocky land".

(3) SANDY-FIELD PLANTS

The association of plants grouped under this title is not at the present day well defined in Barbados. It is meant to include the plants that inhabit the sandy soil immediately backing the expanses of pure sand which border the coast in many regions some distance inland from the grey dunes described above, and consists of grey dune plants (such as *Lippia reptans, Pectis humifusa* and often the Binding Grass (*Paspalum distichum*), along with a few erect herbs such as those mentioned below. Near Bridgetown on the coastal strip which lies between the Engineer's Pier and Needham's Point, the sand-field plants consist chiefly of the West Indian Tea (*Capraria biflora*); the Vervain (*Stachytarpheta indica*); one or two species of grass; the leguminous Indigo Bush (*Indigofera tinctoria*), and the Wild Coffee (*Clerodendron aculeatum*).

On the whole, the plants of this ill-defined association are somewhat xerophytic and hardy. They live in a substratum which contains some organic matter but which is mainly sandy, and therefore dry and warm. In most regions the association merges on the one hand into the true sandy-beach association and on the other, into the belt of sandy-bushland which marks the landward limit of the low lying coast in those districts where no sea-cliffs occur.

(4) SANDY-BUSHLAND PLANTS (Coccoloba Association)

Many of the sandy beaches of Barbados possess an association of small trees

and bushes which succeeds the low-growing vegetation (when this is developed) on its landward side. At the present day this association is nowhere of any great extent, but it is sufficiently distinctive and common to deserve mention. It may be termed the "Coccoloba Association" because the dominant plant in it is the Sea Grape (see page 229, Warming. Bibliography No. 8). In former times it may have extended for a considerable distance inland in many of the lowlying coastal regions of the Island, judging by the occurrence of isolated specimens of several of its common members in places which, although nowadays surrounded by cultivated land, must once have been unfitted for the growth of all but certain plants of a specialized kind.

The most typical area in Barbados in which the Coccoloba Association is to be found, is on the south coast of the Island below St. Ann's Fort at the Garrison. This area in question is partly Government land and partly a section of Mr. Craig's land. Although its features have been somewhat altered by the artificial planting of certain trees, it still retains many of the characteristics of a natural planting association. The land is low-lying, extending backwards from the sandy beach (which possesses a psammophytic vegetation very much like that already described) to a steeply rising rocky cliff of height some 20 feet, situated at a distance of about 200 yards from the sea margin. Immediately to the west of the area lies a small expanse of marshy land populated by sedge, and to the east of it, the low rocky cliff comes forward until it borders the sea, meeting the water at a point some 500 yards east of the marsh, and thus forming the boundary of the area on two sides. The substratum in which the trees and shrubs are growing is almost pure sand. There is a little organic matter in it, the amount of this approximating 1.3% as determined by chemical analysis. The level of the ground is three or four feet above sea level in that part of the area which adjoins the sandy beach. Further inland it sinks some what, and then rises gradually to the foot of the cliff at the back. The water table is at a depth of nearly 1 to 1½ feet at the lowest point in the area, distant some 80 yards from the beach. A sample of the water taken from this place and analysed shows that the water supply is not very saline, for it contains less than 0.3% of dissolved solids, of which a quarter is organic matter and the rest almost pure sodium chloride (common salt).

The limiting conditions of plant growth in this region are thus seen to be poorness of soil in nutrient salts, and the presence of a waterlogged under layer of sand which exists at a comparatively small depth below the ground surface, and may, in many places in very wet weather, even coincide with the level of the land itself.

We will now describe the nature of the vegetation which is to be found in this area.

Besides the Sea Grape, low trees or bushes of the following species occur in the Coccoloba Association:—Manchineel (*Hippomane mancinella*); White Wood (*Tecoma leucoxylon*); Seaside Mahoe (*Thespesia populnea*); White Acacia (*Leucaena glauca*); Sweet Briar (*Acacia farnesiana*); Galba (*Calophyllum calaba*); Scarlet Cordia (*Cordia sebestena*); and certain low shrubs such as the Wild Coffee (*Clerodendron aculeatum*); and the liane known as the Soldier Bush (*Tournefortia volubilis*). The herbaceous undergrowth varies somewhat according to the nature of the soil. In the marshy places, certain sedges abound, but in the more sandy regions, the undergrowth plants are of the

same general nature as those of the sandy-field association already described. It may even include certain sandy-beach plants which have migrated from the districts directly bordering the sea. Of special interest is the unique occurrence of a leguminious trailing plant of the general habit of the Goat's foot Ipomaea, Its name is *Canavalia obtusifolia*. This plant possesses large, smooth, tough compound leaves of three leaflets each, and bears racemes of purple pea-like flowers which give rise to long broad pods. *Canavalia* grows on the beach in this locality, and extends well into the sandy soil region of trees which succeeds it. It is uncommon on beaches of Barbados other than the one under consideration, but is extremely prevalent in sea shore associations of certain other West Indian islands and of Eastern Asia and Australia.

Another beach plant which is also nowadays uncommon in Barbados but which is common in other West Indian Islands, found growing on the margin of the sandy bushland area under discussion, is the Seaside Parsley (*Ambrosia crithmifolia* (*hispida*). This is a member of the family Compositae and is characterised by its crinkled leaves. Patches of it occur to the east of the area near Needham's Point Lighthouse.

Examining the botanical characteristics of the trees in the above list of names, we notice that in the case of the White Wood, Galba and Cordia, the leaves are of a xerophytic nature, that is to say, they are more or less protected from excessive loss of moisture by a tough leathery layer or cuticle. In the case of the other trees, however, no such well-marked xerophytic feature is noticeable, so that we must find some other explanation for the constant occurrence and apparent adaptation to conditions of the trees of the Coccoloba Association. It is hard to decide which characteristics are of importance in this connection, partly because the state of our knowledge is not sufficient to enable us to arrive at definite conclusions as to the relation between soil conditions and plant form, and partly because no exhaustive examination of the mode of development and the peculiarities of the root systems of the plants in question has yet been undertaken. It is possible that the solution of the problem lies in the nature of the root systems of the trees, for in many cases it is to be remarked that the plants possess abnormally deep and wide spreading roots, that is, where sufficient root room has been available for the unrestricted growth of the under-ground parts of the trees. This feature is well illustrated by the root system of the White Acacia, which is remarkedly adaptable to the varying conditions of water supply occurring in the different regions of the area. The Acacia is a leguminous plant with fine unprotected delicate leaflets, and yet it is able to grow just as well in places where the water supply is small and where the water table is at a considerable distance below ground level, as it is in places where the land is almost marshy. It appears that the plant is able to develop either a long tap-root system or a shallow surface-feeding root system depending on whether the water table lies at a great or at a small depth below ground. A further feature of several of the Coccoloba Association trees is the production of quickly growing deep, tap-rooted seedlings which may be responsible for the establishment of the trees in their peculiar habitat in the first place. Plants with no such vigorous seedlings might be unable to develop rapidly enough to reach the moist regions of the soil before their supply of foodstuffs runs short.

The above suggestions are brought forward simply to indicate the somewhat ignored fact that the features of the root system of a plant may largely decide its success in a habitat not very conducive to the growth of normal plants.

The characteristics described are possessed by almost all the species named above, and this fact alone is sufficient to suggest a probable explanation for the aggregation of these plants into a definite association.

Finally, there also occur in the association of plants of the sandy-soil region under consideration a few species of plants which are known to have been introduced into Barbados by human agency, and in certain cases, to have been actually planted in this particular region within the knowledge of persons acquainted with its history. The Coconut Palm (*Cocos nucifera*) is the commonest of these. This tree thrives fairly well in the peculiar substratum, but the best specimens are to be seen growing where a considerable layer of dry sand overlies the water-logged regions of the substratum. Another commonly occurring tree is the Barbados Almond (*Terminalia catappa*) which characterises sandy-bushland plant associations in Eastern Asia, but which has apparently found the conditions of growth in this sandy-soil region quite favourable. The fact that the Almond (as well as the other trees of the Coccoloba Association) may be seen here to be reproducing themselves freely from self-sown seeds, indicates that they are entirely adapted to life in this habitat. The case of the Almond is of interest in that it furnishes an example of how a plant not indigenous to a particular country can, on introduction, escape from cultivation and enter into competition with the native plants already constituting a natural plant association.

DESCRIPTION OF CERTAIN PLANTS OF THE COCCOLOBA ASSOCIATION.

1. *Coccoloba uvifera* (Seaside Grape) Already described.

2. *Hippomane mancinella* (Euphorbiaceae) Manchineel.
A small tree with numerous branches, and usually a short trunk. The leaves are elliptical and of a shining bright green colour. They remain on the tree for a long period without being shed. The tree does not lose all its leaves at once, and is for this reason said to be evergreen or non-deciduous. The plant bears male and female flowers on separate axes, it is therefore styled "monoecious" in distinction to plants which bear male organs on one individual and female on another (dioecious plants). The fruit is a drupe, that is, a fleshy fruit with a hard inner layer immediately enclosing the true seed or seeds. The size, shape and odour of the fruit is similar to that of a small English apple, but it contains (as do also the leaves and stems of the Manchineel) a milky juice of an extremely corrosive and poisonous nature.

3. *Tecoma leucoxylon* (Bignoniaceae) White wood.
See under "Shade Trees" in Section II.

4. *Cordia sebestena* (Boraginaceae) Scarlet Cordia.
See under "Flowering Trees" in Section II.

5. *Terminalia catappa* (Combretaceae) Barbados Almond.
An introduced plant. See under "Shade Trees."

6. *Cocos nucifera* (Palmae) Coconut Palm.

This plant originated probably in the western regions of the Panama Peninsula. It is cultivated in most tropical countries to which it has been brought in the majority of cases by man, although occasionally it may have been distributed by ocean currents which are able to bear away its buoyant and resistant fruits. The Coconut was introduced into Barbados very soon after the date of settlement. It is a tall tree with tortuous stem and very numerous unbranched fibrous roots, which come off from the base of the stem and penetrate the soil in all directions. The root system is therefore said to be "adventitious" rather than of the "tap root" type. The leaves are borne in a large cluster. They are long and pinnate, that is, each consists of great numbers of leaflets. The coconut palm can withstand intense sunlight because its leaves are set edgewise to the sun's rays, and the leaflets are protected by a leathery shiny cuticle. The flowers are borne in abundance in a dense inflorescence which is subtended by a large woody bract. They are monoecious. The fruit is a one-seeded drupe of which the outer layer is shiny, green and leathery, merging into the middle layer of fibre which surrounds the innermost hard stony layer, immediately enclosing the hollow seed. The seed has a thin, brown papery covering (or testa) and contains, when young, a sugary juice. The embryo is small and is situated under one of the "eyes" of the "nut." The different parts of the coconut are used in various ways as food (desiccated coconut, coconut oil, &c.), or for making household articles (mats, baskets, brooms, &c.). The vegetative features of the plant are such that it can grow successfully in sandy soil near the sea, and in situations in which the sunlight is intense. The xerophytic character of its leaves enables it to remain uninjured by salty sea breezes, and to minimise loss of water by transpiration.

NOTES ON THE VEGETATION OF OTHER SEA SHORE DISTRICTS OF BARBADOS.

(1.) **Coconut Walk** (near Inch Marlow, 1 mile N.E. of South Point, Christ Church).

A flat stretch of sandy beach of length some 400 yards lining a small bay, here changes into a dune region as it is followed northeastwards. The sandy beach region is very narrow, and exhibits a flora consisting chiefly of Seaside Spurge and Binding Grass. These plants also occur on the dunes, which are clothed with these and other plants so that little of their surface is left uncovered. The dunes are grey dunes. The commonest plants on them are Goat's foot Ipomaea and the grey scrubby Seaside Lavender (*Tournefortia gnaphalodes*. The Seaside Sedge (*Mariscus*), the Duck Weed (*Pectis*) and the White Sage (*Lantana*) are all present.

Immediately behind the sandy beach, a narrow strip of Manchineel, Sea Grape, Lavender, Horse Nicker, French Cotton, Century or Maypole Bush and Spanish Needle (Sandy-bushland plants) occur. Backing the dunes is a low, flat, bare sandy expanse (Coconut Walk) in which numerous coconut palms are growing. Several of these plants occur on the very edge of the dunes and seem to be partly buried by the sand, which cannot therefore have completely lost its mobility.

(2.) Chancery Lane, Christ Church.

Here a long strip of dune-land some 60 yards broad, and situated at a distance of about 10 yards from the sea margin, exhibits a vegetation of grey dune type. The Seaside Lavender occurs plentifully on the tops of the sand hills, and a close network of Goat's-foot stems covers their slopes. Other members of the sandy beach and dune plant associations also occur in less conspicuous array, and at the back of the hills on their landward side, Sea Grape is abundant. A few Coconut Palms are growing on the flat land behind the dunes, and here also an undergrowth of Vervain (*Stachytarpheta indica*) occurs.

The swamp itself supports an example of a plant which is able to thrive very successfully in a sandy substratum containing much saline water. In those parts of the swamp where the brackish water has been temporarily or permanently drained away, a striking bright green carpet of the succulent halophyte—*Iresine portulacoides*, completely covers the surface of the substratum. *Iresine* will be described in the next chapter, since it is also commonly found on rocks as a lithophytic halophyte. Occasionally another succulent halophyte, the wax-coated Wild Lavender (*Heliotropium curassavicum*) accompanies *Iresine* on the swampy sand.

(3.) Foul Bay, the Crane Beach and Long Bay Beach, St. Philip's Parish.

In these three localities, the sea shore vegetation consists of a zone of poorly developed sandy-beach plants backed by patches of sandy-dune bushland, consisting chiefly of Sea Grape and Manchineel. Here and there Coconut Palms occur. The vertical cliff which rises from the shore to a height of some 40 or 50 feet terminates the flat rocky land which borders the coast in this part of the Island.

(4.) The Scotland District Coast.

The sandy-beach vegetation here is not very different from that of other places in Barbados. The beach has an average width of 20 yards, and supports a fairly characteristic assemblage of sandy-beach plants, consisting chiefly of Binding Grass, Goat's foot and Seaside Spurge. North of Round Rock, and between it and Long Pond, a strip of low, grey dune-land of width some 30 yards, immediately borders the railway line. On the landward slopes of the dunes a grassy vegetation occurs. The duneless parts of the shore to the south possess a poorly represented vegetation of the sandy-bushland type, consisting almost entirely of clumps of Sea Grape. Occasionally indications of grassy sand-field vegetation are to be seen here and there, and less frequently, small areas of salt-marsh Sedge.

(5.) Leeward Coast of Barbados.

The narrow beach which lines the coast for most of the distance between Harrison's Point and Bridgetown is at the present day notably devoid of sandy-beach vegetation. The bare stretch of sand between the tide marks is succeeded almost immediately by a narrow zone of sandy bushland of which the Manchineel and the Sea-Grape are the chief representatives. Near

Freshwater Bay, the luxuriance of these trees is especially conspicuous. It is possible that in former times the development of the Coccoloba Association in many places along the Leeward Coast was quite extensive, and that alternating with this association of plants, regions of salt-marsh, mangrove swamp and sandy-field plants may have occurred.

(B) LITHOPHYTES (or Rock Plants).

(1) PLANTS OF SEA CLIFFS. (SEA-CLIFF HALOPHYTES).

The habitat presented to plants by the surface of rocks near the sea is, of all habitats, one of the most forbidding and unflavourable. Not only is the substratum composed of hard rock, but the whole situation is exposed to the spray cast up by breakers, and to salty foam and wind which deposit saline matter on rock surface and plant alike. It is therefore not surprising that the flora of sea-cliffs is scanty, and consists only of a few very specialised plants. In order to understand the nature of the adaptations which sea-cliff plants exhibit, it would be well to describe one or two examples.

The commonest and most typical sea-cliff halophyte in Barbados is the Seaside Samphire (*Sesuvium portulacastrum*). This plant is found in all parts of the coast where sea-cliffs occur; it is especially plentiful on the Christ Church coast below Spencers' Estate, and on the coast of St. Lucy's Parish in the north of Barbados.

DESCRIPTION OF THE COMMON SEA-CLIFF HALOPHYTES.

1. *Sesuvium portulacastrum* (Aizoaceae) Seaside Samphire.

The plant hangs in flat masses on the vertical cliffs, or lies on ledges and along the margins of the cliffs in conspicuous red and green expanses. The stems of the plant are prostrate, and often radiate on all sides from a common point which is the place of attachment to the summit of the root system. The roots search out crevices and hollows, or flatten themselves against the rock, so that the plant is firmly held in position. A little organic matter, formed by the decay of leaves collects round the roots, and plays a part in holding up water near them. The leaves of the Samphire are cylindrical and rounded at the extremities. In certain cases they are almost spherical in shape. The average length is ½ to ¼ inch. The young leaves are bright green and the older leaves transparent green passing into red at the tips. Many of the old leaves are entirely red in colour, and are often mistaken for "berries" by casual observers. The leaf tissue is very succulent. This is due to the abundance of cell-sap and to the smallness of the intercellular spaces. The cell-sap is somewhat salty, for the plant absorbs a certain amount of saline matter which is said to be the cause of the thickening of the leaves, and of the partial suppression of some of the green colouring matter (chlorophyll). The presence of much cell-sap probably prevents the salinity of the cell contents from becoming high enough to bring about the poisoning of the plant. (N.B. It is interesting to note in support of this account of the direct effect of salt in producing

a characteristic form and structure of the leaves of a plant, that specimens of the Samphire with leaves flattened and expanded like ordinary green leaves are frequently found growing in Barbados on non-saline substrata. All stages may be traced in the plant between succulence and this latter form of leaf,—indeed the change from one to the other may even be induced artificially in pot culture experiments). The flowers of the Samphire are star shaped, pink in colour, and diameter about ½ inch. The fruit is a small capsule, containing numerous tiny seeds easily spread in drift timber.

2. *Portulaca oleracea* (Portulacaceae) Purslane.

This plant has also two forms, a succulent form on sea-rocks, and a flat-leaf form on the soil of waste sandy places, or of cultivated land. The latter is the commoner. The succulent form possesses translucent pink stems, and fleshy, but somewhat flattened leaves, which are of a pale green colour, often passing into pink at the margins. The flowers of the Purslane are small and yellow in colour. The habit of the plant is very similar to that of the Samphire. The seeds are small, and are easily spread by animals or by drift timber.

3. *Iresine portulacoides* (*Philoxerus vermicularis*) Amarantaceae. No common name.

Here again two forms are known. The seacliff form is however the commoner in this case. Iresine has already been mentioned as a salt-marsh plant in connexion with the vegetation in the region near Chancery Lane, Christ Church. The leaves are succulent, pale yellowish green, and of a globular to elongated-cylindrical shape. The flowers are tiny and membranous. They are borne in large numbers in a straw-coloured cylindrical head of length up to 1½ inches. The habit of the plant is similar to the last.

4. *Heliotropium curassavicum* (Boraginaceae) Wild Lavender.

A woody herb, much branched, and of height 1 to 2 feet. The numerous leaves are small, narrow, stalkless, fleshy, and are covered with a very fine layer of wax, which by reflecting and scattering light, gives the plant a particularly noticeable appearance. The inflorescence is a short one-sided cyme which is curved, and which bears a row of small white flowers. The fruit is a small black structure, consisting of four woody nutlets. The seeds may be spread in drift timber.

5. *Strumpfia maritima* (Rubiaceae) No common name.

This plant is found in abundance on the sea-rocks of the St. Philip coast of Barbados. It is a small shrubby plant, with much-branched woody stems, which are covered with a scaly black bark, and which bear very numerous, green, succulent, but not very thick leaves. The average length of a leaf is about 1 inch. A characteristic feature of the plant is the abundance of small white berries, which succeed the

pale-pink flowers. The leaves of the plant drop off after a time, leaving their scaly stipules attached to the stem. The root system ramifies in the crevices of the rocks, and attaches the plant very firmly to the cliff face.

(2) PLANTS OF ROCKY LAND.

There are many waste places in the coralline region of Barbados where the bare rock protrudes above the surface of the ground, and where soil is almost altogether absent, or occurs only in small hollows or pockets. These waste places support a dry scrubby vegetation, which imparts a desolate appearance to the landscape. In certain Antillean Islands such as St. Croix, similar scrubby vegetation covers quite extensive areas, and has been termed the "Crotoneta Association" from the name of one of its commonest members —Croton (see Egger. Bibliography No. 22). In Barbados there are few places only where this association is typically developed. Perhaps the best representation of it is to be seen on the very edge of the inland cliff which borders the first plateau near Mt. Brevitor Estate in the Parish of St. Peter. At this place, the ground consists almost entirely of bare coral rock, in the crevices of which the plants of the association are rooted. Only a few shallow pockets of soil occur, and these are never of any great extent. To the west of the area towards French Village, the ground is also rocky, but larger expanses of shallow soil interrupt the rockiness. This soil supports a vegetation of the "dry pasture" type (see later), so that at this place the association is of a mixed nature. Returning to the description of the pure Crotoneta Association as developed near Mt. Brevitor, it is to be noticed that, because of the scantiness of the water supply, the plants of the association are of the xerophytic type. They differ markedly however, in general appearance from the xerophytes of sandy districts, as will be seen when certain of the plants are described in detail. The species most common in the association in the region named is perhaps the shrubby red flowered sage (*Lantana camara*). Other plants of similar general appearance are the White Sage (*Lantana involucrata*); the Seaside Sage (*Croton flavens*); and the Black Sage (*Cordia cylindristachya*). The following woody herbs or shrubs also occur:—Wonder of the World (*Bryophyllum calycinum*); the Wild Guava (*Psidium guajava*); the Belly-ache Bush (*Jatropha gossypifolia*;) and the Sickle-leaved Spurge (*Phyllanthus epiphyllanthus*). A few fairly tall bushes or trees of general spiny nature also occur here and there. The commonest of these are:—Black Thorn (*Pisonia aculeata*); Sweet Briar (*Acacia farnesiana*); and Cure for All (*Plucheá odorata*).

The majority of these plants are evergreen and woody, with more or less stiff, rough and resistant leaves. Growing amongst them a few plants with fresh green, glossy foliage stand out conspicuously. Of these, *Chomelia fasiculata* (Rubiaceae) is by far the most common, although the Wild Coffee (*Clerodendron aculeatum*) occurs occasionally in this locality, and much more commonly in other rocky districts where the conditions of plant growth are not quite so exacting. Finally, the presence of the attractive ornamental plant, Periwinkle (*Vinca rosea*) (which is in all probability an escape from gardens) in occasional patches in places where a little soil has accumulated, must not be ignored.

On the whole the vegetation is of an "open" character, although on examination, it is seen that, wherever pockets of soil occur, these are populated by collections of small prostrate plants (such as various species of leguminous plants and certain kinds of grasses), which belong to the "dry pasture" type of plant association, to be considered later.

DESCRIPTION OF THE ROCKY-LAND PLANTS.

(N.B. Most of these are extremely common in many localities of Barbados (such as roadsides, waste places, &c.) They are of particular botanical interest because of the adaptation which the plants show to environment. It is therefore intended to give a rather full description of each of them.)

1. *Lantana Camara* (Verbenaceae) Red Sage.

A shrubby plant of height up to 4 feet. The numerous straggling branches bear short spines here and there. The leaves are oval, slightly toothed, and of length up to about 2½ inches. The leaf surface is rough owing to the presence of numerous scaly hairs, which impart a dull appearance to the green colour. The leaves and stems contain an aromatic juice which may in part tend to minimise loss of water by transpiration, although this effect is perhaps negligible. Such aromatic substances in plants are probably only waste products which happen to have a sweet smell. The structure of the leaf, and the presence of the resistant covering on its surface, undoubtedly check transpiration considerably so that the plant is able to live on a dry rocky substratum. The nature of the root system of the plant may, however, be an even more important factor in accounting for the success of the Sage in its peculiar environment. The roots are apparently able to ramify into any crevice, channel or hole, and to derive moisture from the porous interior of the coral rock. One frequently sees specimens of Sage apparently growing straight out from the middle of a lump of bare rock. The flowers of the Red Sage are borne in flat clusters. The young flowers are of a bright, brick-red colour, passing into yellow as they get older. The fruits are small black drupes and are probably carried by birds, which thus bring about the dispersal of the seeds.

2. *Lantana involucrata* (Verbenaceae) White Sage.

A shrubby plant with stiff straight branches which are spineless. The leaves are smaller than in the last species, and possess rounded teeth (crenulate margins). They are greyish-green in colour, and aromatic. The plant possesses similar root characteristics to the last. The flowers are pink in colour, and are subtended by green leaf-like bracts. They occur in clusters, each of which is borne at the end of a straight stalk in the axil of the last four leaves at the end of a branch. The round drupes are purplish-pink in colour and shiny.

3. *Croton flavens* (Euphorbiaceae) Seaside Sage.

This is a low shrubby plant with stiff woody branches. Its leaves are pale greenish-grey when young, turning to a bright saffron or salmon-pink when old. The leaf surface is covered with flat stiff-branched hairs, and the cuticle is tough and thick, so that the plant is xerophytic. The flowers are small and white, and are borne in terminal racemes. The fruit is a small capsule. Any part of the plant when cut exudes a resinous milky juice.

4. *Cordia cylindristachya* (Boraginaceae) Black Sage.

A fairly tall shrub, much branched, with narrowish oval leaves of average length 2 to 3 inches attached to the stems by very short stalks. The leaf is rough and scaly. Its under surface bears numerous small downy hairs. The flowers are borne in terminal racemes. They are small, white and cup-shaped. The fruit (when ripe) is a red drupe of diameter ⅜ inch.

5. *Bryophyllum calycinum* (Crassulaceae) Wonder of the World.

This peculiar plant is a native of Asia, and was probably introduced by man into Mexico, from whence it has spread (either by natural or human agency) into the West Indian Islands. Its presence, as a well established member of the rocky land plant association of Barbados, is therefore remarkable. It reproduces itself freely in many habitats of the Island, and is found in most localities of rocky waste land. The plant is a woody juicy-stemmed herb, whose long red branches have a somewhat trailing habit. The ends of the branch turn up, however, and bears rows of fleshy oval leaves, the average length of which is about 3 inches. The margin of the leaf is slightly toothed, and from the indentations, rootlets arise when the leaf is detached from the parent plant and placed under moist conditions. These rootlets in time are accompanied by shoots, so that *Bryophyllum* possesses a unique method of vegetative reproduction, which makes it an especially interesting object of study. The thick leaf (covered by leathery cuticle) and the general succulent nature of the plant, show it to be a xerophyte, and to be adapted for life in dry environments. The flowers of *Bryophyllum* are pendant, and are borne in tall racemes. Each is tubular in shape and gives rise to a compound or "aggregate" fruit consisting of four slender, pod-like follicles.

6. *Psidium Guajava* (Myrtaceae) Wild Guava.

A shrubby plant which never reaches a great height in rocky places. It possesses rough leaves. Its flowers give rise to fleshy berries which contain seeds probably dispersed by birds. The Guava in cultivation frequently grows into a tall tree.

7. *Jatropha gossypifolia* (Euphorbiaceae) Belly-ache Bush.

A woody herb with a thick upright main stem and few branches. It grows to a height of about 3 feet. The leaves are deeply incised with 3 to 5 lobes, the young ones reddish black in colour, and the old bright green and shiny. All parts of the plant (except the matured bark-covered stem) bear numerous sticky, glanular hairs. The deep crimson flowers are small, and are borne in terminal cymes. The fruit is a conspicuous oblong capsule of length ¾ inch. It contains three chambers with a large ornamented oily seed in each. The plant is a very common wild plant of waste places, and probably owes its success in dry habitats to its extensive and searching root system, and to its somewhat resistant leaf surface.

8. *Phyllanthus epiphyllanthus* (Euphorbiaceae) Sickle-leaved Spurge.

The common name of this woody plant is derived from the shape of its flat green appendages which, however, are not leaves at all, but transformed stem structures. This we know because they bear tiny flowers and fruits along their margins, and also because they are borne in the axils of scale-like, modified leaves, and therefore have the position of side-branches on the main stems. The Sickle-leaved Spurge is often rooted in crevices of bare rock where soil is almost quite absent. Its very tough, well-protected, leaf-like stems ("phylloclades") and its bark-covered stems, enable it to retain moisture.

9. *Pisonia aculeata* (Nyctaginaceae) Black Thorn.

A large, deciduous, trailing shrub which bears numerous branches set at right angles to the stem and to each other. It possesses dark-coloured bark, and is armed with numerous curved spines. The leaves are oval, and each is accompanied by two spines at its base. The leaves are leathery, but are shed in the dry season, so that the plant loses little water by transpiration during the periods of most severe drought. The flowers are tiny, and are borne in compact axillary and terminal cymes. The fruits bear sticky glands, and adhere to anything that touches them.

10. *Acacia farnesiana* (Leguminoseae—Mimosoideae) Sweet Briar.

This small shrubby tree deserves special notice, since at first sight it seems not to possess vegetative characteristics suited for its life in a dry habitat. The leaf consists of 4 to 8 side-appendages, each of which is made up of 10 to 20 tiny leaflets. It is said to be therefore, a "bipinnate compound leaf." During very dry weather most of the leaves drop off, thus effectively checking loss of water from the plant. The smallness of the leaflets, and their ability to close up or fold together at night (sleep movements), serve also as efficient means of minimising loss of moisture. The plant has, further, a very wide-spreading root system, so that it can obtain a very considerable supply of water from all but the driest substrata. The

flowers of the Sweet Briar are tiny, and are borne in dense yellow heads which look like small fluffy balls. They are sweet smelling. The pods that succeed certain of the flowers in the head, are twisted, black and thick. They contain when green a sticky juice, which when extracted from them may be used to make ink by mixing it with green vitriol solution. The Sweet Briar probably originated in America. It is widely spread over the World, and seems to be able to live in almost any habitat. It has come to have such a world-wide distribution because of the very resistant and buoyant nature of the seed-pod which can withstand unharmed, the action of sea water for many months.

11. *Pluchea odorata* (Compositae) Cure for All.

A common shrub with rough leaves which emit an aromatic odour when bruised. The plant, (except the older stems) is covered with a whitish down. The flower heads are heliotrope in colour. The seed possesses a hairy pappus and is wind borne.

12. *Chomelia fasciculata* (Rubiaceae) No common name.

A short stiff shrub with small woody spines and glossy, green, oval leaves, each of length ¼ to ½ inch, and borne in pairs on the stems. The flowers occur in small groups in the leaf-axils. They are small, 4-lobed, odorous and white. The fruit is a deep purple berry of length ⅜ inch. Several of them are borne at the ends of pendant slender stalks in groups in the axils of leaves.

13. *Clerodendron aculeatum* (Verbenaceae) Wild Coffee.

A shrubby plant which sometimes grows to a considerable size. Its leaves are bright-green, glossy and oval. The straight young branches are usually covered throughout their length with foliage, and the older branches possess strong spines which have been left by the leaf stalks when the leaves fall off. The narrow, foliate, tubular flowers are borne in great numbers in clusters all along the branches. They give place to brown woody, spherical fruits. The Wild Coffee is so called because its leaves emit a coffee-like odour when bruised.

14. *Vinca rosea* (Apocynaceae) Periwinkle.

A little-branched, erect, woody herb with pale green, oval leaves, and showy pink flowers, which are borne either singly or in groups of two or three in the leaf-axils. The corolla of the flower is flat, and is divided into 5 segments. It is funnel-shaped with a narrow tube. The fruit consists of two pod-like follicles joined at their bases. It is a "compound" or "aggregate" fruit. The Periwinkle is cultivated in gardens in Barbados. (See "Plants of Gardens"). It is probably an introduced plant, and has escaped from cultivation and gained access to other localities where it seems to thrive under almost adverse conditions of plant growth. *Vinca* has been spread everywhere in the tropics by man.

The plants described above are all common species in Barbados, and many of them will be mentioned again in subsequent pages. They do not include all the typical rock plants to be found in the Island, but they together make up the association of lithophytes as seen at Mt. Brevitor.

It might be advisable at this place to mention the names, and briefly to describe the features of a few other very common rocky-land plants occurring in certain regions of Barbados other than that just considered.

There is, at the very north of the Island, a desolate region of flat bare rocky land which borders the rugged sea cliffs of the coast of St. Lucy's Parish. The vegetation of this region is very scanty, and none but a few plants of xerophytic nature can grow there. The rugged, pitted and creviced surface of the rocks furnishes a very unfavourable habitat for plant life. Further, in addition to the lowness of the rainfall and the general absence of soily substratum, the wind in this region is persistent, and of considerable violence. Fianlly, those parts of the area immediately bordering the sea receive a certain amount of saline matter from the spray and salt wind which blow over them. At the edge of the cliffs the halophytic Seaside Samphire (*Sesuvium*), and occasionally the glaucous Wild Lavender (*Heliotropium curassavicum*) occur. Further inland, growing in shallow pockets of saline sandy debris prostrate plants such as *Lippia reptans*, Duck Weed (*Pectis humifusa*), and Binding Grass (*Paspalum distichum*) may be seen. The true Lithophytes here include Seaside Sage (*Croton flavens*), and less abundantly, White Sage (*Lantana involucrata*), and Belly-Ache Bush (*Jatropha gossypifolia*). There occurs also another xerophyte of striking appearance and of wide distribution within this area of rocky land. It is the Prickly Pear (*Opuntia tuna*), and a description of its chief features will be found below. This plant seems to thrive in Barbados on almost bare rock, although it is well able to succeed in a dry, sandy substratum (instance its prevalence over extensive areas on the dry plains of the United States, Australia and other countries).

In certain other rocky districts of Barbados, a few other species of lithopyhptic plants not yet mentioned are to be found. Of these, the herbaceous Laurel leaved Spurge (*Pedilanthus tithymaloides*); the tall columnar cactus (*Cephalocereus*): and the well-known Maypole or Century Plant (*Agave americana* and other species, are the most interesting. They may be found growing in many dry rocky districts, such as the edge of the high coastal cliffs on the leeward side of St. Lucy's Parish, and the slopes of Chalky Mount in the Scotland District.

DESCRIPTION OF THE ADDITIONAL ROCKY-LAND PLANTS.

1. *Opuntia tuna* (Cactaceae) Prickly Pear.

The above-ground part of this plant is made up of a series of flat, thick, oval, green structures, which are attached in rows to a short, thick round stem. It grows to a height of anything up to 4 feet. The size of the mature oval segments is about 1 foot by 6 inches, by 2 inches thick. The segments are actually modified stems, and are able to function as leaves. They bear numerous clusters of long

yellow spines, at the bases of which cushions of tiny brittle hairs occur. The large flowers are arranged along the margins of the segments (or "phylloclades"). They give rise to red succulent berries, which contain numerous seeds. The berries also are furnished with cushions of brittle hairs. The succulent nature of the green segments, the presence of a thick smooth skin, which forms their outer covering, and the relative smallness of the area of the plant's surface are xerophytic features which partly account for the ability of the Prickly Pear to live in a dry habitat. The tenacious and much-branched root system of the plant enables it to obtain anchorage in, and to absorb water from a rocky substratum. *Opuntia* is probably disseminated by birds.

2. *Pedilanthus tithymaloides* (Euphorbiaceae) Laurel-leaved Spurge.

An erect, usually almost unbranched plant, with stems of uniform thickness of about ½ inch, and of height up to 2 feet. The leaves are thick, leathery, oval, smooth, waxy, and green. They are arranged in two ranks and are inclined at an acute angle to the stem. These leaf-features are characteristically xerophytic. All parts of the plant contain a copious milky juice. The flowers are irregular in shape and red in colour. They resemble in appearance an upturned human foot in miniature (hence the name). The fruit is a 3-chambered capsule.

3. *Cephalocereus* (*New Species?*) (Cactaceae) columnar cactus.

This cactus has erect greenish stems, which come off from a main stem and turn upwards, giving a candelabrum-like appearance to the plant. The height of the plant may be anything up to 8 feet. The stems are about 4 to 6 inches in diameter. They are leafless, but are furnished with numerous clusters of long spines situated at short intervals along ridges which run longitudinally down the stems. There are usually 10 such ridges and 10 shallow furrows. Flowers of large size are borne occasionally on the stems. The absence of leaves and the cylindrical shape of the green parts of the plant, cause its surface area to be small compared with the total bulk of the plant. A tough covering also protects the surface. Hence, for its volume, the cactus loses little water by evaporation. Finally, the fact that the plant-tissues are succulent, enables the cactus to store up water, and thus to resist periods of extreme drought. Cacti are xerophytes of the most pronounced type. They show a very marked modification of plant structure which is entirely in keeping with their environment.

4. *Agave americana* (Amaryllidaceae) Maypole Bush or Century Plant.

This plant just prior to its flowering period, consists of numerous very stout, long straight, fibrous, green leaves, arranged, rosette-like round a short central stem-axis. The length of a mature leaf is between 3 and 4 feet. At the apex of each leaf, is a short spine, and the leaf-margins also are furnished with short spines set closely together. The tissue of the thick leaf is succulent, and the surface is protected by a tough skin covered with a layer of wax

which, however, is not very conspicuous. The root system is fibrous and wide-spreading. The *Agave* is a typical xerophytic plant, and is of slow growth. When the plant has reached a certain size it commences to put out its flowering axis, which consists of a quick-growing, green, stout, erect, stem-like structure. This reaches a height of some 10 to 20 feet, and is furnished with regularly arranged, green, pointed, leaf-like bracts. The inflorescence is a large terminal, branched panicle of numerous yellow flowers. Each flower is of length about 3 inches, and possesses honey glands, producing abundant nectar, which attracts humming birds and bees in large numbers. Frequently, in this and in certain closely-related species, many of the flowers are later replaced by "bulbils,"—that is, instead of the fruits developing small leafy seedling-like plants grow out from the inflorescence or from the main axis. Eventually the young plants so produced fall to the ground near to the parent, and here continue growth. When an *Agave* has finished flowering, the axis dies down. The leaves have previously commenced to wither, their stored contents having been used in producing nutriment for the reproductive organs. The whole plant thus comes to an end after a more or less extended period of growth (which may be as long as 10 years in Barbados, or even 100 in certain other countries) so that the plant is in a botanical sense an "annual" plant in that its life ends with the production of reproductive organs.

(N.B.). In the name Century Plant is implied the long life period of *Agave*, and the name Maypole Bush may signify that it produces its tall flowering axis at the commencement of the wet season (in May), during which season many of the mature plants embark on their vegetative effort).

It is supposed by one authority that the well-known Barbados Maypole Bush described above is a species common only to Barbados. It has, therefore recently been named *Agave barbadense*.

5. *Agave vera.* This is very similar to the above in vegetative habit.

(3) PLANTS OF VERTICAL ROCKY WALLS.

The peculiar gullies of the coralline region of Barbados have already been described in some detail. It was indicated in that description that a gully presents many different kinds of habitats to the growth of plants, and that, on the whole, the vegetation of gullies is luxurious because of the general moistness of the environment, and because of comparative freedom from interference by man.

For convenience of ecological description, a typical Barbados gully may be considered as consisting of five more or less distinct regions:—

(i) **The vertical gully wall (of height anything up to 150 feet).**
(ii) **The gully floor.**
(iii) **The sloping sides of the gully.**
(iv) **Stationary talus slopes.**
(v) **Caverns.**

In many places in a gully, the sides are vertical from the very floor, and

frequently they overhang. In other places, the ground rises from the flat floor at a more or less steep angle, and meets the vertical wall at a point varying in height from the floor in the different parts of the gully. Occasionally the sloping ground between the floor and the wall is formed of loose material which has fallen down from the cliffs during weathering. This loose material constitutes the "talus" mentioned in the above list. The caverns are situated in the vertical gully wall usually in those places where the wall rises immediately from the floor.

It is intended to deal only with the plants of the gully *wall* in this place, because these plants furnish further examples of Barbados xerophytic lithophytes whose features differ somewhat from those of the lithophytes already considered.

(i) PLANTS OF THE VERTICAL WALLS OF GULLIES.

The wall of a gully is never smooth, but is pitted and pocketed into numerous cavities of all sizes. Many of these contain an appreciable amount of detritus mixed with decaying vegetable matter, and thus furnish habitats of various kinds for the growth of certain plants whose seeds chanced to have been transported thereto. The rock of a gully wall, being of coral limestone, is very porous and prone to weathering. The original structure of the coral is frequently discernible, and within many of its tubular passages the roots of plants of the gully wall are to be noticed growing into the moist interior of the rock in search of water.

The habitat in which the gully-wall plants grow is therefore peculiar, and we should naturally expect to find in the plants special features which account for the success of certain species of constant occurrence in such an environment. In the first place, gully-wall plants are placed under conditions where the water supply is not plentiful, and most of the larger plants derive the greater part of what moisture they obtain from the porous rock itself. No plants can thrive on the gully wall unless they possess well-marked xerophytic features. These will be expected to include such features as we have already learnt to connect with plants living under conditions of drought. Amongst them may be mentioned, (1) arrangements of leaves so as to produce mutual shading; (2) smallness of leaf-surface so as to reduce the area from which water may be lost by evaporation; (3) succulence or fleshiness of leaf-tissues for purposes of water storage; and (4) the presence of a thick epidermal covering accompanied perhaps by a layer of wax or of hairs or scales for purposes of protection. It is interesting to note here that certain gully-wall plants supplement the water supply which they derive from the support to which they are attached, with moisture obtained by means of "aerial roots" which sometimes reach down to the ground and penetrate the soil there.

In the second place, gully-wall plants possess root systems which securely fasten the plants against the rock face. It has already been mentioned how the roots of certain of these plants ramify into the channels and crevices of the rock. In many cases clinging roots are developed; these adhere to the bare rock and are usually adventitious, being produced from the stems of the plants and not from the main root system. Many gully-wall plants produce only roots of this kind. Such plants belong to the Monocotyledon class of flowering plants, and are represented chiefly by Orchids and species of Araceae.

Finally, no plant can become established on a vertical rocky wall unless its seeds are carried in the first instance to the places where the plant finally becomes fastened after the germination of its seeds. Further, unless those seeds germinate quickly and produce young roots capable of attaching the seedlings to the wall, there will be litte chance of the species becoming represented in the vegetation of that particular habitat. The plants growing freely and naturally on Barbados gully-walls are indeed found to have means of dissemination of their seeds entirely in keeping with their mode of life. Many of them possess succulent fruits which are small enough to be eaten by birds,—the birds swallowing the seeds eventually to eject them again in places on the rocky face or in cavities and shelves of the gully wall. In certain cases, the fruits (or the seeds contained in them) are sticky, so that they adhere to beaks of the birds, and are carried by them to places on the gully wall where they are wiped off and left. Those gully-wall plants which do not possess succulent or sticky fruits, reproduce themselves by means of seeds which are small enough to be blown about by the wind. There is therefore some chance of the seeds of this kind of plant reaching clefts and cavities of the gully wall where they might germinate under conditions entirely favourable to them.

Let us now turn our attention to the actual plants that are found growing successfully on the vertical gully walls of Barbados, and enquire in each case into the degree of adaptation exhibited towards the environment in which the plant is placed.

Foremost amongst the plants that inhabit the rock-face are certain fairly large *xerophytic shrubs* to be named hereafter. The roots of these shrubs are found ramifying and bending in and out from pocket to pocket, and giving off rootlets that penetrate into the interior of the limestone. The shrubs grow most abundantly high up on the gully wall, and they possess long dangling air-roots which form a conspicuous feature especially when they are clothed with masses of other twining plants, which make use of any support in order to spread their leaves to the light. Frequently the dangling air-roots reach the floor of the gully where they penetrate into the soil, thus aiding in the supplying of water to the plants. From many of the larger pockets, *xerophytic* plants with a tuft-like habit grow out. A large-leaved fern is especially to be noticed along with other ferns, and also occasionally a Bromeliaceous plant with long leaves. Not so abundant are Orchids and Araceae. Next come *creeping succulent herbs,* which also root in the scanty soil in the cavities, and run from pocket to pocket or flatten themselves against the bare rock. Amongst them may be mentioned a creeping Cactus (*Cereus sp.*), which is occasionally seen high up on the gully wall, and also several Piperaceous plants which are abundant and conspicuous lower down the rocky face.

The kinds of plants thus far indicated are true "clinging" plants, and are found almost exclusively attached to supports. For this reason they are frequently termed "epiphytes." Certain of them are able to live on the branches of trees, as for instance, Orchids and Araceous plants. Orchids include perhaps, some of the most typical epiphytes known.

In addition to true epiphytes, certain *erect, succulent herbaceous plants,* and occasionally one or two typical *rock-plants* (such as those described previously), are to be seen growing out of the larger cavities of the gully wall, or perched up on ledges on its face.

(a) Epiphytic Shrubs of the Gully Wall.

1. *Clusea rosea* (Guttiferae) Balsam Tree.

A shrub with leathery leaves and conspicuous dangling roots. The leaves are oval and about 5 inches long by 3 inches broad. The flowers are large and pinkish; the crimson fruit is fleshy and very sticky, so that birds carry away the seeds and deposit them high up on the gully wall on ledges or in cavities.

2. *Ficus sp.* (*laurifolia*) (*Moraceae*) Bearded Fig.

(See under "Shade trees"). Small specimens of this tree are occasionally seen growing on gully walls as epiphytes. The seeds are probably disseminated by birds (such as pigeons) that eat the small "figs."

3. *Sapium aucuparium* (Euphorbiaceae) Poison Tree.

(See "Plants of the Forest"). The leaves of this epiphytic shrub are elliptical, and of length about 5 inches. They are leathery, and contain (as do also the stems) copious milky juice. The fruit is a 3-chambered capsule, the seeds of which are probably disseminated by birds.

(b) Tufted Epiphytic Plants of the Gully Wall.

1. *Campyloneurum latum* (Polypodiaceae—Filicineae) Hart's Tongue Fern.

The leaves are simple, 1 to 3 feet long, 3 inches broad, with unindented margins, tapering bases, and roundish ends. They are stiff and leathery, and bear clusters of tiny sporangia dotted all over the under surfaces. The spores are dust-like, and are dispersed by wind, thus accounting for the presence of the fern in many cavities of the gully wall.

2. *Gymnogramme calamelanos* (Polypodiaceae—Filicineae) Silver-backed Fern.

A fern common along rocky waysides.

3. *Bromelia pinguin* (Bromeliaceae) Pinguin.

The leaves are narrow, of length 2 to 5 feet with spiny margins, and red sharp-pointed apices. They form a deep, cylindrical, water-tight cavity where they overlap at the base of the plant. The water which collects there is stored for the use of the plant, which absorbs it by certain hairs that grow out from the leaf surface. The roots have lost the power of absorption, and simply serve to hold the plant against the rocky wall. The flowers are borne in spikes. The fruit is a fleshy berry, and is probably dispersed by birds.

4. *Epidendrum ciliare* (Orchidaceae) Eyelash Orchid, Wild Lily, &c.

The leaves of this plant are thick and rigid. Their length is between 4 and 8 inches. They are attached at their base to thickened stem-structures (known as "pseudo-bulbs"), which serve as water-reservoirs. Frequently the leaves drop off from the pseudo-bulbs in very dry weather. The roots are of two sorts:—clinging roots (which hold the plants fast against the rock face, and which give out rootlets that absorb nutrient from the humus in the cavities), and dangling roots (which absorb moisture from the air by means of a special absorptive outer layer—the "velamen"). The flowers are sweet-scented, white and large. They are borne in a spreading raceme. The 'petals' (perianth members) are 2 inches long and quite narrow; their lips are fringed. The fruit is a dehiscent, elongated capsule, which contains a very great number of tiny dust-like seeds. These are easily disseminated by wind. *Epidendrum* flowers in gullies chiefly during the wet season.

5. *Anthurium Nuegelii* (Araceae) Anthurium.

The leaves of this plant are elliptical, leathery, of length between 6 and 12 inches and of breadth 1 to 4 inches. The flowers are borne on a fleshy spike (of length usually about 3 inches) subtended by a narrow greenish bract, (of length equal to that of the spike), and carried on a stalk of length up to 12 inches. There is no true stem, the leaves being attached at their bases to a disc-like structure from which numerous roots are given off and hold the plant tightly in position.

(c) Succulent epiphytic creepers of the gully-wall.

1. *Peperomia obtusifolio* (Piperaceae).

A creeping plant with fairly succulent, leathery, elliptical leaves, which taper at the base into the leaf-stalk. The ends are rounded. The leaves are 1½ to 3 inches long, and 1 to 2 inches broad. The stems are pink in colour and branching. At each node numerous roots are given off. The flowers are minute, and are borne close together on a fleshy spike of length about 4 inches. The fruit is a small berry and is dispersed by birds.

2. *Peperomia acuminata* (*guadaloupensis*). (Piperaceae).

This plant is similar to the above, but has a rather well-marked forked method of branching. The leaves are about 2 inches long by about 1½ inches broad, and are obtusely pointed at the ends.

3. *Peperomia pelucida* (Piperaceae).

This grows in the damper and more shady parts of the gully wall. It is a delicate plant with translucent stems and leaves. The latter are acutely pointed, and seldom more than 1 inch long. They are thin and not very leathery.

4. *Cereus triangularis* (Cactaceae) Creeping Cactus.

The triangular green stems of this creeper are sparsely branched, and of width between 1 and 2 inches. They bear groups of 4 or 5 spines at intervals along their edges. The flowers, when produced, are very large and white. The fruit is egg-shaped and spiny. It is difficult to see how its seeds may be disseminated in Barbados, but probably birds are the agents of dispersal.

(d) Erect succulent plants of the gully wall.

These include two plants of importance commonly found growing on rocky land. They are *Bryophyllum calycinum,* (Wonder of the World), and *Pedilanthus tithymaloides* (Laurel Leaved Spurge).

(e) Erect plants with rough leaves of the gully wall.

These are also found in the rocky-land association. The chief of them are, *Lantana camara* (Sage); *L. involucrata* (White Sage); *Croton flavens* (Seaside Sage); *Cordia cylindristachya* (Black Sage); and also *Phyllanthus epiphyllanthus* (Sickle Leaved Spurge), whose leaves are really modified stems.

(N.B. The vegetation of the other regions of a typical gully, will be described in the next chapter when Mesophytes are considered).

CHAPTER X.

THE MESOPHYTE ASSOCIATIONS OF BARBADOS.

(A) MESOPHYTES OF GULLIES.

The vegetation of a typical gully [other than the epiphytic vegetation (xerophytic lithophytes) of the vertical gully wall described in the last chapter] will now be considered. According to the scheme of classifying the different regions of a gully under five headings, it would be advisable to describe the regions designated there as "the gully floor"; "the sloping gully sides"; "the stationary talus slopes"; and the "caverns" separately and in turn.

(II) PLANTS OF THE GULLY FLOOR.

The sorts of habitats presented by the different regions along the bottom of a gully are far too numerous to classify satisfactorily. A few general statements may be made, however, regarding the extreme conditions that occur there. First of all, the atmospheric conditions in the gullies are different from those of other localities. The air is more stationary in them than over the fields above. One notices in a gully an oppressive heat which is not evident on the open land, because of the persistent trade-wind. The almost entire absence of movement in the air of a gully, combined with the generally moist state of the soil, causes the humidity of the gully atmosphere to be considerably higher than that of the open fields. Secondly, the light conditions in a gully are very variable. In certain places along the gully floor, the sun's rays beat down uninterruptedly on to the growing plants, but in other places, the gully floor plants are protected from the direct rays of the sun either by taller plants, or by overhanging rocks. Extreme shade occurs in the caverns, which will be considered separately.

Regarding the soil conditions in gullies, we recognise at once numerous variations from the normal conditions. These are impressed by the differences in depth of the soil, and in the varying supply of water. In certain places, for instance, the bare rocky floor of the gully protrudes through the soil. In other places, deep pockets of rich, moist soil occur, and yet in others, the substratum consists of loose stones more or less surrounded and covered with soil. These localities of loose stones gradate into the talus slopes which form a more or less distinct regional division of a typical gully. Here and there in a gully floor marshes occur, and very occasionally, running or stagnant water.

When one considers that all these kinds of habitats occur along the base of a gully of no very great extent, and that they merge imperceptibly one into the other, one is not surprised to find that the plants of a gully floor are very varied, and include many distinct types frequently growing in close proximity. One sees there few trees, however, but the profusion of shrubs, herbs, climbers and creepers is often very striking, reminding one of the plant-life in typical moist tropical districts such as occur in Trinidad, and certain other of the

West Indian Islands. The following examples will serve to indicate the range of varieties in the plants of gully floors.

(a) Trees of the Gully Floor.

Chlorophora tinctoria (Fustic); *Citharexylum quadrangulare* (Fiddle Wood); *Hura crepitans* (Sandbox); *Sapium aucuparium* (Poison Tree); *Eriodendron anfractuosum* (Silk Cotton); *Haematoxylon campechianum* (Logwood); *Acrocomia sclerocarpa* (Macaw Palm), and various cultivated gully trees, which are nowadays mostly in a state of neglect. The chief of these are *Citrus* spp.; *Spondias spp.* (Plums); *Anona spp.* (Sugar Apple), (Sour Sop); occasionally *Myristica fragrans* (Nutmeg); *Coffea arabica* (Coffee) and *Pimenta acris* (Bay Tree).

(b) Shrubs of the Gully Floor.

Of those already mentioned as belonging to other habitats, *Caesalpinia crista* (similar to Horse Nicker in appearance); *Clerodendron aculeatum* (Wild Coffee); *Pluchea odorata* (Cure-for-All); *Solanum igneum* (Bitter Berry); *Tecoma stans* (Shrubby Yellow Bignonia); and *Psidium guajava* (Guava) may be noted. The following shrubby plants are quite common and conspicuous either by reason of their showy flowers or their striking foliage.

Foremost amongst them are certain Rubiaceous plants, such as *Gonzales spicata; Psychotria undata, Faranaea odoratissima, Chiococca racemosa, Guettarda scabra, Chomelia fasciculata, Randia aculeata,* and *Ixora parviflora;*—all of which possess smooth, unindented, opposite leaves, of more or less oval shape and spiky or loose racemes of odorous white flowers, which are followed in most cases by small, yellow, red or purple berries. These plants are especially found in moist shady spots in gullies, and are seldom seen elsewhere.

The Acanthaceous *Thyrsacanthus nitidus* (so common in the undergrowth of Turner's Hall Wood), and the Melastomaceous *Miconia laevigata* (with its characteristically net-veined leaves) also deserve note. Other species of Melastomaceae besides the last named occur occasionally, together with many large-leaved plants of the genus *Solanum*, and certain species of the spreading small-leaved Myrtaceous genus, *Eugenia*. Of interest is the rare occurrence of the tall grass, *Bambusa* (Bamboo).

Finally, many shrubby plants common as weeds of pastures and roadsides, are found growing in the dry and exposed places on the gully floor. Practically all those plants of this category named in any of the plant-lists to follow, may be seen growing in the varied habitats of Barbados gullies.

(c) Erect Herbs of the Gully Floor.

These also are very numerous and varied. They include almost all those mentioned in connection with other habitats, such as rocky land, pastures, wayssides and waste places.

(d) Creeping Herbs of the Gully Floor.

Here again, most of the prostrate plants of certain other habitats grow in profusion amongst the other gully plants. Leguminous and Euphorbiaceous creepers are especially abundant in gullies.

(e) Climbing Herbs of Gullies.

These are generally rooted in the soil of the gully floor, but occasionally they may be found growing from pockets in the rocky wall. They climb up the aerial roots of the epiphytes or up the stems of the erect trees, shrubs and herbs. When in flower, they form a characteristic feature of the flora of a gully.

The climbers of Barbados gullies may be classified into twining plants and tendril climbers.

The *twining plants* twist in a spiral manner up their supports, and have long slender stems, with leaves relatively far apart. The leaves are usually displayed so as to prevent mutual shading, and their surfaces are placed at right angles to the rays of light. The *tendril climbers* have slender outgrowths (tendrils) which are sensitive to contact. The tendrils may be modified stems, leaves or inflorescence-axes (peduncles). The vegetative characteristics of tendril climbers are otherwise similar to those of twiners.

Twiners:

Convolvulaceae.

1. *Ipomaea sideafolia.* Christmas Wreath.
   A large quick-growing plant, resembling somewhat a sweet potato vine. The flowers are fairly large, and of a white or purple colour. They are borne in cymes. The leaves are cordate in shape, and of length about 3 inches.

2. *I. umbellata.* Hog Vine.
   A large plant with clusters (umbels) of bright yellow flowers, each of diameter 1 inch. The leaves are cordate, and of length about 2 inches. The numerous fruits are pale-brown, brittle capsules.

3. *I. sinuata.* Noyeau Vine.
   A large plant with white flowers each of diameter 1½ inches. The leaves are deeply divided, usually into 5 lobes.

4. *I. pentaphylla.*
   This plant is characterised by its hairy stems and leaf-stalks. The hairs are long, soft and yellow in colour. The flower is white, and of diameter ¾ to 1 inch. The leaves are deeply divided each into 5 pointed, elliptical lobes, and are of length about 2½ inches.

5. *Jacquemontia pentantha=Convolvulus pentanthus.*
   A slender plant of quick growth. The flowers are pale blue in colour,

and are borne in groups of 3 or more in the axils of the small cordate leaves.

Other Families:

6. *Abrus precatorius.* (Leguminoseae,—Papilionatae) Crab's eye Vine.
This plant has slender branched stems, which are woody at the base, and which bear pinnate leaves consisting of 10 to 12 pairs of small oblong leaflets. The flowers are borne in racemes at the ends of leafless branches. They are small and of a pale purple colour. The fruit is an oblong woody pod of length about 2 inches. It dehisces on the plant and exhibits its scarlet seeds, each of which has a black spot at the base.

7. *Clitoria ternatea.* (Leguminoseae,—Papilionatae) Blue Vine.
A slender plant, with pale-green pinnate leaves, each of 5 fairly large leaflets. The flowers are axillary and solitary. They are of a bright blue (or sometimes white) colour, and have a recurved and flat round standard. The fruit is a narrow legume of length about 4 inches.

8. *Thunbergia fragrans.* (Acanthaceae).
A slender twiner with lanceolate leaves each of length about 2½ inches. The flowers are axillary, solitary, white, sweet smelling, tubular, with flat corollae of diameter 1 inch. The fruit is a beaked capsule containing 2 to 4 seeds.

9. *Tragia volubilis.* (Euphorbiaceae) Vine Nettle.
A long twining plant with woody base. The leaves are lanceolate, 2 inches long, and serrated along their margins. The male flowers are tiny, and are borne in small many-flowered racemes. The female flowers are solitary and axillary. The fruit is a capsule. The leaves, stems and capsules are covered with short fine stinging hairs.

Tendril Climbers:

(a) *Possessing tendrils which are modified stem-branches* (i.e. borne in axils of leaves.)

Passiflora foetida. (Passifloraceae) Love-in-a-Mist.
A slender hairy climber, with 3-lobed leaves of length about 3 inches, and flowers (similar to the Passion Flower or to that of the Water Lemon), of diameter 1 inch. The fruit is a small berry, surrounded by a net-like envelope of green threads. The tendrils are borne in the same axils as the flowers.

(b) *Possessing tendrils which are modified leaves.* (i.e. borne on the stems opposite to leaves, and often bearing stems or flowering shoots in their axils.)

(1) *Momordica charantia* (Cucurbitaceae) Cerassee.
A slender plant, with deeply divided leaves. The flowers are either male or female. They are of a yellow colour and fairly large. The female give rise to conical, orange-coloured berries, which contain numerous flat, bright, red seeds. The fruit is about 2½ inches long, and is covered with short tubercles. The tendrils are twisted up in narrow coils.

(2) *Peponia* sp. (Cucurbitaceae) Wild Cucumber.
A slender climber with 5-lobed, pointed leaves of average length 2 inches. The flowers (male and female) are white. The fruit is an ellipsoidal green berry, turning red when ripe. It has pinkish pulp which smells similar to cucumber. Its length is 2 inches. The tendrils are coiled.

(3) *Smilax* sp. (Liliaceae) Wild Sarsaparilla.
A tall climber, armed with small prickles, and bearing sub-cordate leaves of average length 4 inches. The leaf has 3 to 5 longitudinal nerves, and bears two tendrils at its base, so that they may be said to be modified leaf-stipules. The flowers are tiny, and are borne in axillary groups. The fruit is a spherical berry (green when young and black when ripe) of diameter about ¼ inch. It contains 2 or 3 seeds.

(c) *Possessing tendrils which are modified inflorescence axes.* (Peduncles.)

1. *Vitis* (=*Cissus*) *sicyoides* (Vitaceae) Poison Withe or Scratch Withe.
A high climber, with stiff stems and numerous cordate leaves of length about 3 inches. The flowers are very small and are borne in flat forked pink umbels, which form a very conspicuous part of the vine. The fruit is a small black berry, which is eaten by birds, its seeds being thus spread by them.

2. *Serjania nodosa*=*Paulinia cururu* (Sapindaceae) Bastard Supple Jack or Sucking Bottle.

A tough woody liane with angular flexible stems and petiolate leaves. The leaves are trifoliate, each leaflet being elliptical and pointed, and of length about 3 inches. The petioles are winged. The tendrils come out opposite to the leaves, and are coiled like a watch spring (i.e flat spiral). Occasionally they occur in the leaf axils. The flowers are small, and are borne in small axillary groups. The fruit is a pear-shaped capsule, containing 1 to 3 black seeds.

3. *Cardiospermum halicacabum* (Sapindaceae) Wild Parsley or Heart Seed.
A slender herbaceous vine, with deeply incised serrated leaves, each of length 1½ inches. The small flowers are borne in axillary groups, the axes of which also bear at their summits 2 thread-like tendrils each. The fruit is a green, bladder-like, 3 winged capsule, diameter ¾ inch, which contains three deep-purple spherical seeds. Each seed has a small white heart-shaped mark at its place of attachment.

(III) PLANTS OF THE SLOPING GULLY SIDES.

In those parts of a gully where one or both sides of the ravine slope upward more or less steeply toward the vertical gully-wall (which may or may not be very prominent in those places), the vegetation is of a different type from that of the moist gully floor. The conditions of growth, (due chiefly to the nature of the substratum and to the drainage of the soil), are such that typical mesophytes cannot thrive, and the community of plants developed on the slopes resembles more the rocky land type than that of the gully floor. In many places, bare rock is exposed on the slopes; in others, the soil is very shallow, and is liable to be washed down by rain. The conditions of light are strong, and altogether the growth of plants, other than those of a xerophytic nature, is almost prohibited.

The common plants growing on gully slopes are grasses (such as Sour Grass and certain other more or less prostrate forms); the rocky land plants *Lantana camara* (Red-flowered Sage), *Cordia cylindristachya* (Black Sage); *Lantana involucrata* (White Sage); and the shrubby *Pluchea odorata* (Cure-for-All); and finally, a few hardy mesophytes such as *Cassia polyadena* (Wild Tamarind); *Stachytarpheta indica* (Vervain); *Corchorus siliqulosus* (Broom Weed); *Synedrella nodiflora* (Porter Bush); *Desmodium incanum* (Sweetheart); the prostrate, daisy like *Wedelia gracilis; Euphorbia heterophylla* (Red Milkweed); the slender, twining, pale-blue flowered *Jacquemontia pentantha;* the shrubby Melastomaceous *Miconia laevigata,* and the feathery *Pilea microphylla,* which hangs in tress-like masses from the moister surfaces of the projecting rocks. These mesophytes are also fairly common on the loose talus slopes next to be described.

(IV) PLANTS OF THE STATIONARY TALUS SLOPES.

Gully talus slopes consist of fragments of rock detached from the gully wall, or washed down from the land at the top of the gully, mixed with a certain amount of soil. The soil has accumulated by the weathering of rock fragments, and by the decay of the plants, or by transportation of soil from the land at the top of the gully by rivulets of rain water started during the wet season.

The soil conditions of gully talus slopes are therefore peculiar. Usually the stones are not covered with soil, so that those plants which are found growing on the talus are rooted in the scanty soil which occurs in the interstices between the stones. The water supply of these plants is precarious; on the whole, it is scant, since the drainage of the talus is quick and exhaustive. The only reliable source of water is that which is held in the soil between the rock fragments, and this is liable to fail during dry weather, especially on talus slopes in those parts of the gully that are exposed to the direct rays of the sun.

The vegetation of gully talus slopes is somewhat similar to that of sloping gully sides. It consists chiefly of prostrate creeping plants which possess extensive perennating root-systems that ramify between the stones. Foremost amongst them are certain grasses such as the broad-leaved pink-tipped, *Paspalum fimbriatum,* along with *Sporobolus indicus* (Wire Grass) and species of *Panicum.* An interesting carpet plant of frequent occurrence is *Wedelia gracilis* (Compositae). This plant is said to have been introduced in comparatively recent times into a Barbados garden and to have escaped from thence into other habitats, such as wayside banks, orchards and gullies. It is found in all parts of the island. It possesses herbaceous stems which bear numerous adventitious roots at the nodes. Other prostrate plants of the talus slopes are *Euphorbia prostrata* (Milk Weed): *Pilea microphylla* (=*P. muscosa,*—Euphorbiaceae), and *Desmodium incanum* (Sweetheart). Here and there erect herbs occur. These are chiefly quick-growing annual weeds, such as *Emilia sonchifolia* (Compositae); *Bidens pilosa* (Compositae) and *Euphorbia heterophylla* (Red Milkweed). Occasionally, deep-rooted plants with persistent woody stem-bases grow up between the stones. *Stachytarpheta indica* (Vervain) is the commonest of these, although *Sida* spp. and other similar plants more typical of dry pastures frequently occur along with it on many gully talus slopes.

(V) PLANTS OF THE GULLY CAVERNS.

In certain places at the base of the gully wall, there occur caverns, usually of no very great size, which present conditions favourable to the growth of several distinct kinds of mesophytic plants of sufficient interest to deserve special mention.

The caverns have been produced chiefly by the undermining action of the torrential streams to which the original formation of the gullies was due. In many cases they have been enlarged by the solvent action of subterranean water, or by the falling in of overhanging masses of rock near their mouths. Every grade of cavern is represented, from slight concavities in the gully-wall to deep excavations extending inwards and perhaps downwards for a distance of some forty feet.

The intensity of light in the deeper caverns is small. In their innermost parts it may be so low that few or none of the higher plants can thrive. Usually the only plants that occur in these dark recesses are blue-green algae, which form a slimy, greenish layer on the rock surface. The atmosphere inside the caves is humid, and frequently the walls are bathed with trickling water which comes out of the coral rock. The soil on the floor of the caves and on the ground near their mouths is usually moist and rich in humus. On the whole, the conditions are different from those of any habitat so far described.

The chief characteristic of gully-cavern plants is that they possess no structural modifications which might aid in checking loss of water by transpiration. This is no detriment to them, since water is plentitful. Their leaves are often large wide-spreading, and so arranged as not to keep light from one another. Their blades are very thin and smooth, and of a rich dark-green colour. These characteristics are peculiar to plants that grow in shady moist places. Such plants are, therefore, often classed together as shade plants.

The chief *shade plants* of Barbados gully-caverns are:—

1. *Piper aduncum* (Piperaceae) Rock Bush or Elder Bush.
   This will be described later as a common undergrowth plant of Turner's Hall Wood. It is typically developed at the mouths of or just within gully caverns.

2. *Goniopteris tetragona* (Polypodiaceae,—Filicineae.)
   A large-leafed fern with deeply divided thin fronds.

3. *Tectoria sp.* (Polypodiaceae,—Filicineae).
   A large-leafed fern whose leaves are divided into 3 or more squarish segments.

4. *Caladium sp.* (Araceae) Wild Eddoe.
   A tufted plant with arrow-shaped leaves of length about 1 foot.

Nearer the cave mouths, Rubiaceous plants abound. *Thyrsacanthus nitidus* is also common, as well as other erect plants which live best in rather subdued light.

Covering the moist walls of the caverns in regions where the light is sufficiently intense for growth to proceed, a few distinctive species of plants occur. The chief of them are:—

1. *Asplenium dentatus* (Polypodiaceae,—Filicineae) Asplenium Fern.
   The leaves of this small fern are 3 to 6 inches long, and are deeply divided into pinnae (each of length ¼ to ½ inch) arranged along both sides of the midrib.

2. *Phymatodes sp.* (Polypodiaceae,—Filicineae)
   A small feathery fern which grows best on those parts of the rocky wall where water is constantly trickling.

3. *Funaria sp.* (Muscineae) Funaria Moss.
   A small true moss which covers fairly large areas of the moist cavern wall with a bright green velvety layer. It is also found covering stones on the floor of the caverns.

Near the mouth of the caverns where the light is stronger, and the water-supply is not so constant, occur:—

4. *Gymnogramme calomelanos* (Polypodiaceae—Filicineae) Silver-backed Fern.
   The fronds of this fern are rigid and covered with a white powder beneath. They are deeply divided into pinnae, which are again divided into pointed lobes. The length of the frond is from 6 to 12 inches, rapidly tapering, being 2 to 4 inches broad at the base.

5. *Pilea microphylla* (=*muscosa*) Euphorbiaceae).

(B) GRASS AND HERB MESOPHYTES OF DRY PASTURES.

The areas of land that go by the name of "pastures" in Barbados are of two kinds:—

(1) **PERMANENT PASTURES.**—which should more strictly be called *meadows,* since animals are not allowed to graze on them. The majority of them are of Sour Grass. A few small pastures or meadows of Guinea Grass and a less number still of Para Grass also occur.

(2) **DRY PASTURES.**—of mixed vegetation, consisting of grasses of various sorts together with non-gramineous perennials, and a few annual plants.

(1) PERMANENT PASTURES.

The vegetation of these cannot be included under the heading of "Pure Plant Associations," since the chief plant in each of them (i.e. Sour Grass, Guinea Grass and Para Grass) has originally been planted by artificial means. Permanent pastures in this sense resemble cane-fields and will therefore be classified as cane-fields in a separate section.

(2) DRY PASTURES.

These are of frequent and ubiquitous occurrence in Barbados. They range in size between small areas of waste land near dwelling houses and estate buildings or along roadsides, to fields probably once under cane cultivation. They serve as feeding grounds for cattle, both those of sugar estate proprietors, and those of private owners and peasants.

In studying the flora of dry pastures, it might first of all be advisable to consider the factors which would be effective in deciding the nature of the association of plants occurring in them. The primary factor undoubtedly is the condition of the soil, especially with regard to its water supply. The soil of dry pastures is, in the main, shallow, of low water content, and of poor tilth, Here and there one notices, however, marked differences in soil condition, even in a pasture of small extent. These differences are due to change of slope, water-capacity and drainage, and they are sufficiently great to affect considerbly the nature of the vegetation from place to place. The general dryness of a typical pasture, however, prevents the establishment of very many plants such as those which can only live through the dry season on deep, moist, porous soil, like that occurring in certain parts of gullies or in cane-fields. Only hardy, relatively- vigorous and extensively-rooted plants can possibly succeed in dry pastures. Of such plants, those whose root-systems are of permanent duration, or those which possess underground storage organs attached to their roots or stems, naturally have the advantage over plants which persist only for a relatively short time. Plants of the former type, unlike those of the latter, are able to grow continuously from season to season, and to retain possession of any site in which they have once established themselves. Further, they are able to use that site as a base from which to carry on a struggle for mastery over other plants in the vicinity. Thus one would expect to find perennial plants rather than short-lived annual plants in a dry pasture in which the vegetation has reached a state approaching equilibrium.

The case of perennial plants with underground storage organs which persist throughout the driest weather, even when the shoots have withered, is especially interesting. Such plants, in a sense, are xerophytic during part of the year, and mesophytic during the remainder. They resemble in effect those trees which shed their leaves in periods of drought, and may, with the latter, be included in the group of plants known as "tropophytes", since they are adapted for life under changing conditions.

The persistent woody herbs also, to a certain extent, show xerophytic habit during the dry season, in that they shed many of their leaves, and so reduce loss of water by transpiration. In certain cases, the leaves are somewhat resistant, so that the plants approximate to xerophytes. Prostrate herbs are able to withstand drought, because their leaves are spread close to the surface of the ground where the air is more damp than it is in the less moist layers at higher levels.

Another factor of importance having bearing on the kinds of plants that are associated together in dry pastures, is the exposure of the herbage to

grazing animals. In order for any given species of erect plant to survive the ravages of grazing animals, it must first of all, be firmly established in the soil and capable of quickly producing new leaf-buds. Perennial plants have this advantage over short-lived plants in so far as their root systems are concerned. Further, those firmly rooted perennials that possess persistent woody stems and branches, are able to produce new crops of leaf-buds almost as fast as the old shoots are nipped off by grazing animals. Prostrate plants are not exposed to the same danger of mutilation as are erect plants, and one would expect, therefore, to find many prostrate plants escaping destruction and growing normally in dry pastures, and this is indeed the case. The faculty of being able to defy the attacks of marauders is not possessed by all short-lived annual herbs, except they contain obnoxious juices, or are covered with formidable prickles.

Finally, a ready means of seed-dispersal may favour rapid spread (especially on freshly exposed or "new" lands), apart from the slower means of vegetative increase brought about by the growth of underground parts. Many typical members of the dry pasture plant association produce seeds or fruits which are furnished with spines or adhesive glandular hairs whereby they are enabled to stick to the feet and legs of grazing animals which thus bring about their dissemination.

The following lists of dry pasture plants of Barbados should be studied, therefore, with a view to elucidating the relationships between the nature of the pasture flora and the various and intricate factors to which the plants are exposed.

Speaking generally, it may be stated that the vegetation of a Barbados dry pasture consists of (a) several kinds of grasses, (b) certain prostrate herbs (chiefly Leguminoseae), and (c) several species of erect plants. Occasionally (d) stunted shrubs occur here and there, but they do not generally enter into the dry pasture plant association.

(a) GRASSES OF DRY PASTURES.

These occur in flat patches or as low tussocks.

Individuals of one species of grass may form a patch of considerable size, to the almost complete exclusion of other species. Thus, a struggle is constantly going on for total possession. Occasionally as the conditions become favourable, one species of grass may be observed gradually to oust other species from its habitat.

It is believed that even the Sour Grass of the pure pastures or meadows for instance, is being exterminated in certain dry districts of the southeast part of Barbados by a recently introduced grass known as the Antigua Grass (*Andropogon cariosus*), which was originally introduced into the West Indies from the East. Further, it is common knowledge that grasses (such as *Paspalum conjugatum*, *Panicum sanguinale*, and *Panicum prostratum*), frequently displace the more desirable Devil's Grass (*Cynodon dactylon*) on tennis lawns and cricket pitches in Barbados.

In the following list of dry pasture grasses it will be noticed that the most important of the grass species are perennials with persistent root-systems. It will also be noticed that these perennial grasses seldom, if ever, are characterized by the possession of long underground rhizomes. This fact is probably accounted for by the resistance opposed to the lateral growth of long rhizomes by the densely tangled roots of the tufted grass species and of other plants of the dry pasture association. This suggested explanation furnishes an example of the way in which one plant may react on another in a plant association, and of the means whereby one plant may defeat another in the struggle for domination in a particular region.

The commonest and most widely distributed dry pasture grasses are:—

(i) Perennial Grasses (which persist by underground parts).

1. *Cynodon dactylon.* Devil's Grass.
Probably an introduced plant. It possesses short underground rhizomes. Its sub-aerial stems are of marked trailing habit, the prostrate stems frequently rooting at the nodes. These features probably account for its success in competition with the more erect grasses. The pasture Devil's Grass has very narrow and wiry leaves, and the stems are long, slender and often erect at their extremities. It thus differs in appearance from the much coarser sea-shore Binding Grass with which it is occasionally confused.

2. *Andropogon pertusus.* (=*Amphilophis intermedia var. acida*). Sour Grass. (See under "permanent pastures.")
Erect, tufted, but possessing short rhizomes.

3. *Sporobolus indicus.* Wire Grass.
Erect, tufted, but possessing short rhizomes. The inflorescences are long and narrow.

4. *Paspalum conjugatum.* Broad-leaved Savannah Grass.
A prostrate grass with short rhizomes. Grows best in the moister places in pastures.

5. *Paspalum fimbriatum.*
Erect, tufted, with short rhizomes and broad leaves.
Cyperaceae (of grass-like habit). Botanically, these are not true grasses.

6. *Cyperus rotundus.* Nut grass. Cyperaceae.
Erect, tufted, with slender underground rhizomes to which are attached numerous small spherical tubers. The Nut Grass is thus very hard to eradicate when once it is established. It grows best in calcareous soils.

7. *Fimbristylis monostachya,* (and other species). Sedges. (Cyperaceae). These grow occasionally in the wetter parts of dry pastures, but are never common.

(ii) Annual Grasses.

Of lesser importance and more restricted in their occurrence in dry pastures are certain grasses described as annuals (*i.e.* short-lived plants which flower in the first year after their seeds have germinated). These grasses are generally incapable of persisting through a period of serious drought because of the absence of underground parts. Nevertheless they frequently occur in Barbados dry pastures, especially when the water supply is fairly good and the dry season not too severe. They are more common, however, along waysides.

1. *Eragrostis pilosa.*
   A slender, erect, tufted grass, with fairly broad curled leaves.

2. *Eragrostis purshii.*
   Similar to the above, but with narrower leaves.

3. *Panicum prostratum.*
   A prostrate grass, with short stems arranged round the base of the plant. The leaves are short and broad.

4. *Eleusine indica.* Dutch Grass.
   A tufted grass, usually prostrate, with flat leaves.

5. *Eleusine aegyptiaca.* Egyptian Grass.
   Similar to the above in vegetative features.

6. *Chloris radiata.* Plush Grass, Bed Grass.
   An erect tufted grass with narrow leaves. The inflorescence has 5 to 10 (or more) slender racemes which all come out from the very end of the axis.

7. *Cenchrus echinatus.* Burr Grass.
   Stems prostrate at base, and erect at the ends. The inflorescence is a raceme (spike). The fruits are spiny, of diameter ¼ inch, and adhere to passers-by.

8. *Leptochloa mucronata.*
   An erect tufted grass, with flat leaves and loose panicles of flowers.

(b) PROSTRATE HERBS OF DRY PASTURES.

These vary in abundance and in number of species, according to the soil conditions (especially as regards moisture).

In the driest and most exposed places, xerophytic types are dominant. These include certain plants already described in connection with the vegetation of sea-shore regions. The chief of them are :—

Portulaca oleracea (Purslane); *Sesuvium portulacastrum* (Seaside Samphire); *Pectis humifusa* (Duckweed); and *Lippia reptans.* In places in sandy dry pastures they dominate even over the grasses. Where the soil is a little less sandy and dry, other prostrate herbs along with certain grasses appear. The xerophytic plants are thereby expelled from these moister places, and the

true dry pasture association prevails. It is to be noticed, however, that in the case of *Portulaca* and *Sesuvium,* a marked adaptation to a non-xerophytic habitat frequently occurs, for individuals of these genera possessing thin flat leaves, showing all stages of variation from succulence to the other extreme, are not uncommon in pastures where the soil is neither very sandy nor very dry.

The recumbent and prostrate plants of the more typical dry pastures consist (besides prostrate grasses) chiefly of genera of the family Leguminoseae. These plants grow between the stems and leaves of the grasses and other herbs, and show different degrees of luxuriance in accordance with the amount of moisture present. In very dry pastures, the prostrate herbs are stunted and stiff. The leaves are small and pressed close to the ground. In moister pastures, on the other hand, the stems are elongated, the leaves large, and the whole plant so markedly different from the stunted type, that, were it not for the constant floral features, it might be mistaken for a different species.

Several of the widely distributed prostrate dry pasture plants possess fruits which adhere to the feet or legs of grazing animals. The fruits of the *Desmodium* are especially characterized by this feature.

The commonest recumbent and prostrate herbs of dry pastures are:—

Leguminoseae.

Teramnus uncinatus (Rabbit Vine); *Desmodium incanum* (sweetheart); *D. procumbens; D. tortuosum; Stylosanthes procumbens* and *Rhynchosia minima* (Burnmouth Vine). In the moister regions there occur also, *Desmodium triflora; Phaseolus semierectus* and *Vigna luteola*. The two latter are common cane-field weeds.

Other families:—Prostrate plants less commonly represented in dry pastures). *Euphorbia prostrata* (Milk Weed); *Pilea mycrophylla* (*Muscosa*), and a few other plants which are more commonly weeds of open cane lands.

In moist pastures, *Commelina nudiflora* (Pond Grass) is occasionally found.

(c) ERECT PLANTS OF DRY PASTURES.

These include many species of different families. Their relative abundance in a pasture is decided by the many factors that have already been enumerated. Most of the erect plants are perennials with persistent woody stems. A few are perennials with underground storage organs, and a few are annual plants with herbaceous juicy stems. In the following list the plants are arranged under these heads.

(i) Erect Plants (not Shrubs) with more or less woody and persistent stems

By far the most abundant plants of this class, to be found in every Barbados dry pasture, are the various species of *Sida*. The commonest species is *S. glomerata,* but other species (e.g. *S. carpinifolia*) also occur. These latter are hard to distinguish from *S. glomerata,* and are therefore included with it in the general description.

Sida glomerata (Malvaceae)

An erect woody plant, growing to a height of 6 inches to 2 feet, but sometimes recumbent. It is sparsely branched, but it bears numerous tufts of stipulate, elliptical, dentate leaves, of average length 1 inch. The flowers are yellow, ¾ inch in diameter, and are borne either singly or in groups of two or three, closely seated in the axils of the leaves. The fruit has a brown membranous wall, and divides when ripe into 10 small segments (carpids), each of which possesses 2 spines. The fruit measures about ⅜ of an inch across, and each segment contains one seed. *Sida* seeds are probably disseminated by animals, to whose coats the spinose carpids adhere.

Other species of *Sida* (i.e. *S. urens* and *S. rhombifolia*) of common occurrence in dry pastures, differ somewhat in certain features from *S. glomerata,* but resemble it in general vegetative habit.

The following plants also resemble it in the possession of persistent, more or less woody stems, and of spinose, adhesive fruits or seeds :—*Achyranthes aspera, Boerhavia erecta, B. hirsuta,* (Hogweeds), *Triumfettia semitriloba* (Wild Hemp) and *Abutilon hirtum;* while the following have persistent, more or less woody stems, but possess fruits which are not adhesive, but either capsular or pod-like, and dehisce when dry.

Corchorus siliqulosus (Broomweed); *Desmanthus depressus; Stachytarpheta indica* (Vervain); *Blechum brownei; Beloperone* sp.; *Cassia polyadena* (Wild Tamarind); *Crotalaria retusa* (Yellow sweet pea); *C. verrucosa* (Blue sweet Pea); *Waltheria indica* (Buff Coat); *Capraria biflora* (West India Tea); *Tribulus maximus; Barleria lupulina and Barleria prionitis.*

Of these, *Crotalaria retusa* and *verrucosa* are often very conspicuous in certain dry pastures, not because of the abundance of individuals, but rather because of the showiness of their large racemes of brightly coloured flowers.

(ii) Erect Plants with persistent underground parts.

A few examples of this class of perennials occur in certain Barbados dry pastures. Only one of them is common. The others are rare, but worthy of note as they represent important plant types.

1. *Ruellia tuberosa* (Acanthaceae) Minnie Root or Many Roots.

A common erect plant, growing often to a height of 1½ feet. It is much branched in a regular fashion when freely growing. The leaves are elliptical and of maximum length about 1½ inches. The flowers are large, funnel-shaped and bright blue in colour. They are arranged in cymes in the axils of the leaves or at the ends of the stem branches. The fruit is a narrow, elongated, many-seeded, dehiscent capsule, of length up to 1 inch. The persistent underground organs are true tubers (i.e. modified stem structures). They are about 3 inches long and ½ inch thick. They are arranged radially round the base of the stem. The plant usually flowers at the end of the wet season.

2. *Hypoxis decumbens* (Amaryllidaceae) Yellow Crocus.

This frequents only the moist parts of dry pastures. It is about 9 inches tall, and bears yellow cup-shaped flowers of length ½ inch. The leaves are very narrow. The underground portion is a small pear-shaped bulb. The Crocus flowers and produces leaves only in the wet season.

3. *Hippeastrum equestre* (Amaryllidaceae) Barbados Red Lily, Easter Lily. A very showy plant of height about 1½ feet, bearing an umbel of large, funnel-shaped, bright brick-red flowers. The underground part is a large roundish bulb. The leaves are long, green and strap-shaped. The plant produces flowers in the dry season (January to April). The leaves appear in the wet season. *Hippeastrum* is rarely present in exposed typical dry pastures, but it is occasionally found in the upland districts of Barbados at the heads of gullies especially. It is often grown in gardens as an ornamental plant.

4. *Stenorrhynchus orchioides* (Orchidaceae)
This plant is rarely found in dry pastures, and only occurs in fairly deep soil rich in organic matter. It is interesting in that it is an example of a Saprophytic flowering plant (i.e. a plant which obtains much of its food "ready made" from the humus of the soil in which it lives). The underground parts consist of numerous, thick tuberous roots which do not possess rootlets, but which obtain food by the agency of a fungus, which lives in co-operation with them (symbiosis). The sub-aerial part of the plant consists of a few pale leaves which soon die, and later a pinkish flowering stem of height about 1½ feet, bearing a raceme of unattractive tubular flowers, arises. The plant flowers in the dry season. (March and April.)

(iii) Erect Plants with herbaceous succulent stems. (True annuals).

In many pastures several herbaceous and comparatively short-lived plants occur in spite of grazing animals. They are naturally more abundant in pastures not much used for grazing, and owe their success in competition with other pasture plants probably to their large output of seeds, and their efficient means of seed-dissemination. They are usually eventually ousted by the more favoured perennial plants which have just been described. The majority of these annual weeds grow also by the wayside and in waste places, and will be enumerated when those habitats are considered. They are chiefly species belonging to the family Compositae. Their variety depends to a large extent on the nature of the soil, because this influences the rate at which they can grow and multiply.

Special mention may be made, however, of *Argemone mexicana* (Yellow Mexican Thistle,—Papaveraceae) as it is possible that this annual owes its prevalence in many dry pastures to its numerous spines and perhaps also to its yellow latex, doubtless obnoxious to animals, which thereby learn to avoid the plant. Occasionally, the poisonous *Datura Stramonium* and *D. tatula* (Nightshade or Thorn Apple) survive on certain pastures for the same reason as does also the less harmful Castor oil plant (*Ricinus communis*).

(d) SHRUBS OF DRY PASTURES.

These are uncommon in typical dry pastures. Usually grazing animals eat off the stems of the seedlings of such plants before they reach maturity, or else they are purposely removed by human agency. Certain quick-growing shrubs, and shrubs heavily armed with spines, occasionally thrive in dry pastures. Most of these are characteristic of rocky land, and have already been described in connexion with the rocky land association of Barbados. The chief are:—

Jatropha gossypifolia (Belly-ache Bush); *Lantana* spp.; *Croton flavens; Cordia cylindristachya* (Sages); *Acacia farnesiana* (Sweet Briar); *Solanum igneum* (Bitter Berry); *Clerodendron aculeatum* (Wild Coffee); *Pisonia aculeata* (Black Thorn); and rarely, *Opuntia tuna* (Prickly Pear).

Occasionally specimens of *Pithecolobium unguis-cati* (Bread and Cheese, (a leguminous plant with numerous spines) occur in various parts of dry pastures which have been enclosed by hedges of this plant, or to which its seeds have gained access from some distant source.

It is highly probable that were dry pastures to be left quite undisturbed by man and beast, shrubby plants would gradually replace the herbaceous vegetation, and bring about the conversion of the dry pastures into original scrubby bushland.

(C) WOODY MESOPHYTES OF FORESTS.

The only remnants of the tropical forest which once undoubtedly covered the greater part of Barbados, occur in the Scotland District at Turner's Hall and Foster Hall respectively. The former is the more typical representative of the Mesophytic Forest Association.

TURNER'S HALL WOOD.

At Turner's Hall, the trees clothe the steep northern side of one of the spurs that radiate from the south-western portion of the rim of the Scotland District. The height of this spur at its south-western extremity where it branches off from the rim is about 1,000 feet. Eventually the spur flattens and merges into the alluvial plain which borders the southernmost of the two rivers of the district. The spur is not clothed for the whole of its length with trees, but only for a distance of half a mile from its point of junction with the Scotland District rim, that is, for about a quarter of its length. The average width of the forest is about 300 yards. The soil in which the trees are growing is comparatively dry because of the smallness of the rainfall, and because of the good drainage of the land due to its elevated position. Hence also, the humidity of the air in Turner's Hall wood is low, a state of affairs enhanced by the strong winds that blow over the hill slopes for the greater part of the year.

For these reasons chiefly, the nature of the undergrowth of Turner's Hall Wood (as well as, to some extent, that of its arboraceous flora), differs considerably from that of most tropical forests.

The conditions existing in the Turner's Hall region at the present day are probably not the same as those in existence in former times when the Scotland District for the most part was covered with dense vegetation.

(a) NAMES AND DESCRIPTIONS OF THE FOREST TREES OF TURNER'S HALL WOOD.

1. *Hymenaea Courbaril.* (Caesalpinoideae,—Leguminoseae) Locust Tree.
A tall straight tree, often reaching (in Barbados) a height of 50 feet. The diameter of the trunk is about 4 feet in the older specimens. Massive buttresses often support the trunk at the base. The bark is smooth, brown and soft, and exudes a resin when cut. The leaves are large and compound. They are twice pinnate, the pinnae (or leaflets) being about 1 inch long. During the dry season the Locust sheds most of its leaves (*i.e.* it is a deciduous tree). The flowers are not large, and are borne in terminal groups. They are of a white or pinkish colour, and are sweet smelling. The fruit is an oval, smooth, woody, brown, indehiscent (*i.e.* not splitting open when dry) legume, of length 4 inches. It contains a few large seeds. The wood of the Locust Tree is hard, and was much in demand in the early days of the sugar industry of Barbados for making rollers for cane-crushing mills.

2. *Cedrela odorata,* (Meliaceae) West Indian Cedar.
A tree of height up to 40 feet. The trunk is smooth, straight, of diameter up to 3 feet covered with palish brown bark. The leaves are compound, of 10 to 16 pointed leaflets each of length up to 2 inches. There is an odd leaflet at the end of each leaf axis. The leaves are deciduous. The flowers are tiny, whitish in colour, grouped in loose clusters, and have a peculiar smell. The fruit is a capsule which bursts (dehisces) into 4 valves and liberates the single winged seed, which is carried away from the parent tree by wind agency. The wood of the cedar is of great value in cabinet making. It emits an aromatic odour, is soft, and of an attractive brown colour; it is not attacked by termites (white ants).

3. *Chlorophora* (=*Maclura*) *tinctoria* (Moraceae) Fustic.
A middle-sized deciduous tree of height up to 30 feet. The horizontal branches are often wide spreading; the leaves are oval and pointed. The tree bears either male or female flowers. It is, therefore, dioecious. The flowers on the male fustic trees are arranged in pendulous racemes (called catkins). The flowers on the female trees are grouped together in globular heads, and give rise to compound fruits which are really made up of the several fruits from the numerous female flowers of the head. The Fustic yields a yellow dye. The wood is hard and is put to many uses.

4. *Sapium aucuparium* (Euphorbiaceae) Poison Tree.
A medium sized tree bearing numerous, bright green, elliptical, smooth, shiny, leaves of length up to 4 inches. The tree never sheds all its leaves at once, and is therefore an evergreen. The margins of the leaves are minutely dentate and each possesses two glands at the place where the blade joins the stalk. The flowers are either male or female, and are borne on common axes, which are situated at

the ends of twigs. The male flowers are seated at the extremities of the axes, and the female flowers nearer the twig. The fruit is a small capsule. All parts of the Poison Tree exude a copious white juice (latex) when bruised or cut. This sets to a rubber-like substance on exposure to air. The wood of the tree is of no particular value.

5. *Dipholis salicifolia* (Sapotaceae) Bully Tree.
A fair sized tree with straight trunk, and many branches. The leaves are narrow, and of length 3 inches. They each possess two pointed tips. They are not all shed at once, hence the Bully Tree is evergreen. The flowers are tiny and are borne in great profusion in axillary clusters all along the branches. They are sweet smelling. The fruit is a black one-seeded berry of diameter ¼ inch. The wood was much used in the early days for house building.

6. *Lonchocarpus violaceous* (Papilionatae—Leguminoseae) Spanish Ash.
This well known tree grows to a height of 30 feet. The trunk is straight, stout, and is covered with smooth pale-brown bark. The leaves are compound, each consists of 3 to 4 pairs of oval leaflets of average length 2½ inches. The leaves are shed in the dry season, *i.e.* the tree is deciduous. The flowers are produced in June and July. They occur in pendant racemes, and are of a pale-purple colour. The fruit is a flat membranous pod, which generally contains one seed only. It is pointed at the ends, and of length about 3 inches.

7. *Acrocomia sclerocarpa.* (Palmae). Macaw Palm.
A palm tree of height up to 20 feet, with straight trunk which is densely covered with long black spines. The leaves are large and deeply divided into narrow pointed segments. The leaf axis and stem (peticle) are also covered with black spines. The flowers are borne on a much-branched inflorescence, which is subtended by a large woody, boat-shaped bract (or spathe). There are male and female flowers. The fruit is a hard drupe of diameter ½ inch.

The above-named trees are of most common occurrence in Turner's Hall Wood. There are other species which are found in smaller numbers, namely:—

8. *Hernandia sonora* (Hernandiaceae) Jack-in-a-Box.
Height up to 40 feet. Trunk, thick and straight bearing more or less horizontal branches at some considerable distance from the ground. The bark is soft, and is marked with a network of small ridges. The leaves are very large, (8 inches long) and heart shaped. They are attached to their leaf stalk eccentrically. There are male and female flowers. The fruit is a drupe with a yellow bladder-like envelope, which is the modified and enlarged calyx of the flower. The drupe itself is ¾ inch in diameter, and is black and hard. The wind produces a whistling sound as it blows on the envelope of the fruit.

9. *Hura crepitans* (Euphorbiaceae) Sandbox Tree.
(See under Shade trees).

10. *Bursera gummifera* (Burseraceae) Birch Gum.
Height up to 40 feet. The trunk is usually not very straight. Its bark is shiny brown, and peels off in papery flakes. When cut the bark

exudes a copious transparent gum which smells like turpentine. The leaves are compound, of 3 to 9 pairs of leaflets, each of which is about 3 inches long. The leaves are deciduous.. The small flowers are borne in loose clusters chiefly at the ends of the twigs. The fruit is a drupe with a gummy outer layer. It is ½ inch in diameter, and of a red brown colour. It contains a single seed. The Birch Gum flowers in April.

11. *Oreodoxa oleracea* (Palmae) Cabbage Palm.
(See under Shade Trees).

12. *Eriodendron anfractuosum* (Bombacaceae) Silk Cotton Tree.
(See under Shade trees).

13. *Zanthoxylum fraxineum* (Rutaceae). White Hercules or Harkis.
An evergreen tree of height up to 20 feet. The trunk is slender, and is covered with prominent warty prickles. The leaves are compound, and the leathery green leaflets are of average length 2 inches. The flowers are borne in large loose bunches. The fruit is a splitting fruit (schizocarp) consisting of 1 to 5 segments (follicles), each containing a shiny black seed.

14. *Cecropia peltata.* (Moraceae). Trumpet Tree.
Height up to 40 feet. The branches come off horizontally high up on the stem. The leaves are borne in bunches at the ends of the twigs. The leaf is of characteristic appearance. It is large (diameter 1 foot) circular in general shape, with 9 well marked lobes. The leaf stalk joins the leaf-blade near its centre. The flowers are minute, and several clusters of flowers on separate axes are enclosed or subtended by a single large bract. The fruits are borne in bunches. Each fruit is of small size, is fleshy, and contains one tiny seed. The stems are hollow and sometimes harbour ants.

15. *Citharexylum quadrangulare* (Verbenaceae) Fiddle Wood.
(See under Trees with showy flowers).

16. *Coccoloba grandiflora* (=pubescens). (Polygonaceae) Leather-Coat Tree.
This is a small tree (of height up to about 15 feet), which has a marked resemblance to the common Seaside Grape (*Coccoloba uvifera*). The branches are few. The erect stems bear leaves in regular fashion all along their lengths. Each leaf is almost circular, of width 1 foot, and is seated almost stalkless on the stem. The leaf-base is usually lobed, somewhat encircling the axis. The flowers are borne in terminal racemes, and the fruit is a drupe. The wood of the Leather Coat is hard and red in colour. It was used formerly, when the tree was abundant in Barbados, for the same purposes as the Sea Grape wood is used, namely for making felloes.

17. *Cordia collococca.* (Boraginaceae) Clammy Cherry.
(See under Shade trees).

The above list includes most of the species of trees of considerable size which comprise the present day arboraceous flora of Turner's Hall Wood. The differ-

ent species occur mixed together without any indication of gregarious growth Several specimens of each of the first seven species in the list occur in various parts of the wood, but there are present only two or three of the others mentioned. In former times it is certain that many more species of trees than those named made up the primaeval forest that covered the greater part of Barbados. Schomburgk, for instance, in his "History of Barbados" (1847), includes in his plant list the names of several forest trees that are nowadays either not found at all in Turner's Hall Wood, or are only found occasionally in gullies, or as shade trees near dwelling houses or on sugar estates. It is difficult to decide how far these isolated specimens of trees may help one to reconstruct the full complement of the plants constituting the Mesophytic Forest Association of Barbados as developed in primitive times. This difficulty is due to the fact that many trees have been introduced in the early days as seeds or seedlings from other Islands of the West Indies and from other lands more remote, through the agency of man. Records of such introduction have not been kept, so that we have no reliable data upon which to reckon in our attempt to discover the nature of the primaeval forest of Barbados.

Comparing its present representative, as exhibited at Turner's Hall, (and allowing for the addition of certain other species not now present in it), with the forest flora of such districts as the mountainous and rainy regions of Dominica, Trinidad, &c., we notice at once a marked difference in the number of the various kinds of trees which make up the forests in the contrasted localities. The tropical rain forest of Dominica for example contains at least 176 species of trees as contrasted with the 17 or 20 species found in Turner's Hall wood.

As examples of trees found growing as more or less isolated specimens in different parts of Barbados (especially in gardens) the following may include species that may have once belonged to the original forest flora of the Island. *Erythrina corallodendron* (Devil's Tree or Coral Bean Tree); *Andira inermis* (Wild Olive Tree); *Peltophorum ferrugineum* and *Piscidia erythrina*. These trees are represented in the forests of certain other West Indies Islands and of South America, and, although it is possible that they all were not members of the arboraceous flora of Barbados, yet there is sufficient doubt about their introduction into the Island that one cannot decide whether they are indigenous plants or not.

Returning to the description of Turner's Hall Wood in its present aspect, it may be remarked that, because of the deciduous habit of many of the trees, the appearance of the wood varies somewhat in the different seasons of the year. There is a definite relation between external growth conditions and the periods of leaf fall, of flowering, and of fruiting of trees. This relationship is well shown in certain trees of Barbados, but not so well shown in others. Further, the nature of a tree itself (i.e. the kind of species to which it belongs), and even the individuality of the specimen, have also something to do with the periodicity of its vegetative activity. When the commonest trees of Barbados have been grouped, named and described, certain generalizations will be attempted which will perhaps help to elucidate the question of the periodicity of trees as exhibited in Barbados.

(b) PLANTS OF THE UNDERGROWTH OF TURNER'S HALL WOOD.

Besides the forest trees, there occurs in Turner's Hall Wood a certain number of shrubs and herbs forming the undergrowth. This undergrowth is not so luxuriant nor so varied as that of some tropical forests. The reasons for this are probably to be found in the nature of the soil (especially as regards moisture and humus-content), and in the low humidity of the air. Lianes are altogether absent, as are also epiphytes on the trees. One of the most conspicuous features of typical tropical forests is the presence of epiphytes such as *Tillandsia spp.* (Old Man's Beard and Wild Pine); and certain epiphytic ferns, palms and orchids. These plants almost cover the branches of the trees in the rain forests of Dominica, Trinidad and South America, but are never seen in Barbados.

The undergrowth in Turner's Hall Wood consists of two species of Mesophytic plants, *Piper aduncum* (Piperaceae) (Rock or Elder Bush) and *Thyrsacanthus nitidus* (Acanthaceae). Certain Rubiaceous plants (such as *Psychotria undata,* and *Faramaea spp.*) occur here and there, along with a few species of ferns and of other plants found also in gullies. The two first mentioned plants are shade plants, and they are able to live in the habitat chiefly because of the effect of the trees in eliminating direct sunlight. They form part of the forest association for this reason, and also for the attendant reasons that the soil is moister and the atmosphere more humid than it is outside the wood. Their presence illustrates thereby an important biological factor of plant growth.

DESCRIPTION OF THE TWO CHIEF PLANTS OF THE UNDERGROWTH OF TURNER'S HALL WOOD.

1. *Piper aduncum* (Piperaceae). Rock Bush or Elder Bush.
   A shrubby plant of height up to 10 or 12 feet. The leaves are large, thin, and of an elliptical shape, and pointed at the ends. The average length of a leaf is about 5 inches. The flowers are very tiny, and are borne on an erect fleshy spike which looks very much like a small wax taper. The Rock Bush is a typical shade plant. The leaves are so arranged that little mutual shading occurs, so that, viewed from above, they exhibit a regular pattern, (or leaf-mosaic).

2. *Thyrsacanthus nitidus* (Acanthaceae).
   A woody herb, sparsely branched, and of height up to 4 feet. Leaves thin, oblong and pointed. Inflorescence, racemose, but panicled at the base and terminal. Flower, white, ½ inch long, tubular and sweet-scented. A shade plant showing leaf-mosaic.

FOSTER-HALL WOOD—St. Joseph's Parish.

This second remnant of the primaeval forest of Barbados is situated immediately under the brow of Hackleton's cliff, at a distance of about ¾ mile due south of Foster Hall Estate. It has been partly preserved, probably by the will of former and present owners of the property. The chief differences between the habitat in which the trees at Foster Hall are growing, and that of the forest at Turner's Hall are that firstly, the substratum of the former habitat is rocky and of irregular depth, and secondly that its water supply is to a large

measure derived from the tall limestone mass of Hackleton's Cliff, which passes water by seepage into the rock and soil of the wood at its base. Although the site of Foster Hall Wood faces to windward, yet its position is somewhat sheltered from the direct sea breeze by its proximity to the cliff, and by a slight elevation of the land in front of it.

As regards the flora of the wood, we must discriminate between the "lower wood" and the "upper wood." The lower wood (i.e. the most easterly part) contains the greater proportion of indigenous trees. Its arboraceous flora consists chiefly of *Sapium aucuparium* (Poison Tree); *Cecropia peltata* (Trumpet Tree); *Zanthoxylum fraxineum* (White Hercules); *Bursera gummifera* (Birch Gum); *Acrocomia sclerocarpa* (Macaw palm); *Chlorophora tinctoria* (Fustic); *Citharexylum quadrangulare* (Fiddle Wood); *Coccoloba grandiflora* (=*pubescens*) (Leather-Coat); *Tecoma leucoxylon* (White Wood); one or two species of Fig tree, (of which a large leaved kind, known to the inhabitants of the district as Redwood (*Ficus laurifolia* (?) is especially common), and an occasional specimen of Mastic (*Bumelia mastichodendron* (?)). Most of these species of trees have been mentioned as members of the forest flora of Turner's Hall Wood. There is, however, another tree which is quite common in the lower part of Foster Hall Wood (but much more common in the upper part); the Mahogany (*Swietenia mahagoni.* The mahogany is undoubtedly an introduced tree. Schomburgk adduces reasons (see his "History of Barbados" page 600) for supposing that this the best known and most abundant tree in Barbados at the present day, must have been introduced into the Island by man at some date subsequent to 1750. (The Mahogany is described under "Shade trees"). The tree seems to be suited to the conditions of growth in Barbados, for it reproduces itself from self-sown seeds freely and rapidly in many habitats, especially where deep soil with a fair supply of moisture is available. Thus in Foster Hall Wood, the Mahogany Tree has spread so rapidly that it has produced a great change in the composition of the Wood, especially in its upper part. In the latter region the Mahogany is by far the most abundant species, and it appears to have ousted many of the original indigenous tree species which have not been able to spring up again after the old specimens have been removed by man, or have died a natural death. The undergrowth of the upper part of the Wood has been stifled also by the vigorous seedlings of the Mahogany, so that the aspect of the vegetation here has been entirely changed. Whereas, then, the lower part of Foster Hall Wood includes relatively few specimens of Mahogany, and its arboraceous flora on the whole is similar to that of Turner's Hall Wood, the upper part of the Wood is composed chiefly of Mahogany trees with only a few individuals of other species. Amongst the latter, *Sapium aucuparium* (Poison Tree) is the most abundant, although Fiddle Wood and Fustic are also represented.

Considering the undergrowth of the two parts of Foster Hall Wood, it is to be noticed that the undergrowth of the lower part is very luxuriant in comparison with that of Turner's Hall Wood. The rocky substratum, with its deep pockets of soil, supports a varied flora of tree seedlings (of which Fiddle Wood is especially conspicuous), rock xerophytes (including most of the plants described under "Plants of rocky land") and mesophytes (such as the two shade plants which make up the major part of the undergrowth of Turner's Hall Wood), and along with them, many of the mesophytes of gullies.

It is doubtful, in the face of the abundance of undergrowth plants typical of pure plant associations such as rocky land, whether one is justified in alluding to the flora of lower Foster Hall Wood as a "pure, woody, mesophyte association." It might better be included under "mixed associations."

In the upper part of Foster Hall Wood the undergrowth, as has been stated before, consists chiefly of vigorous seedlings of the Mahogany with relatively few other species of plants.

The lesson to be learnt from a study of Foster Hall Wood is chiefly the marked effect which the introduction of a new and well-adapted plant (in this case the Mahogany Tree) may produce on the characteristics of the vegetation of a mature and natural plant association. This effect is especially well seen in Foster Hall Wood in connection with the suppression of the original undergrowth by the prolific production of seedling plants by the introduced species.

CHAPTER XI.

THE HYDROPHYTE ASSOCIATIONS OF BARBADOS.

(A) TRUE HYDROPHYTES.

The conditions of life of plants which live totally submerged in water, either fresh or salt, are very different from those of plants that live on land, yet true hydrophytes are adapted to their special environment, and exhibit characteristic features. It would be advisable before considering actual examples to investigate the general nature of the factors governing the growth of plants living totally submerged in water, and to examine how far these plants are suited to their special environment.

In the first place, water, which is necessary for the growth of all plants, is here always present in abundance. The whole plant body of a submerged hydrophyte is exposed to it, and absorption may take place through every part of the plant's surface, rather than at one particular region such as the root. The outer skin (epidermis) of the plant may therefore without detriment, be thin instead of thick as is the case of land plants in which protection is needed in order to prevent the plant tissues from losing water excessively by transpiration. Further, an absence of water-conducting tissues in hydrophytes will not be a drawback as it would be in the case of land plants, in which it is necessary for the plant to possess, not only an elaborate absorbing root system, but also efficient conducting tracts for conveying water to all parts of the organism. Secondly, the surrounding water supports the submerged parts of true water plants so that they can expand their green tissues without the aid of stiff upright stems, or of special strengthening fibres. Hence water-plants can grow without the expenditure of much building material. Hydrophytes seldom contain more than 5 per cent. of dry solid matter as compared with 10 to 40 per cent. in land plants.

Thirdly, as regards the air content of the medium in which true hydrophytes live, it must be noticed that carbonic oxide is just as essential for the growth of green submerged plants as it is for ordinary land plants. Natural water (such as that which occurs in the sea, in rivers, lakes and ponds) always contains dissolved air, but this contains a higher percentage of oxygen and of carbonic oxide than does atmospheric air, by reason of the greater solubility of oxygen and of carbonic oxide as compared with that of the third chief component of air, namely nitrogen. In many water-plants, there are present air-chambers and passage-ways for the distribution of the gases liberated during the activities of the green tissues of the plant. These air-chambers also increase buoyancy, which is advantageous to hydrophytes.

Fourthly, the light conditions of submerged hydrophytes are just as important to the successful growth of the plants as of land plants. Light is somewhat weakened in intensity, partly by reflection from the surface of water, partly by absorption in water, and partly by the scattering effect of particles of

solid material which float in water. The deeper the water and the muddier it is, the greater the weakening effect on light intensity. Submerged water-plants are therefore seldom exposed to strong light, resembling shade plants in this respect. They exhibit such features as largeness and thinness of leaf, which we have learnt to connect with shade plants.

Finally, the temperature of the medium in which hydrophytes live is more uniform than that of the environment of land plants. This is due to the fact that water gains and loses heat much more slowly than does air or soil, and plants growing in it are never exposed to sudden changes of temperature as is the case with land plants, especially land plants of temperate countries subjected to frost.

On the whole, then, the conditions of growth of submerged hydrophytes are remarkably uniform, and it is not surprising that aquatic species of plants possess a very wide geographical range. The distribution of the species is brought about under natural conditions by agents such as ocean currents, winds and birds. Ocean currents freely carry floating hydrophytes over great distances; winds transport small seeds of certain hydrophytes from one region to another, and birds, (especially those that haunt ponds and rivers), carry away fruits and seeds of hydrophytes, either attached to mud adhering to their feet, or else contained in their crops or alimentary canals, to be ejected subsequently in another place.

(1) FREE-SWIMMING OR FREE-FLOATING HYDROPHYTES.

These plants constitute several plant associations, of which the most important are the Plankton and the Floating Pond-Association.

(a) PLANKTON.

This term denotes collectively the bodies (either alive or dead) of minute organisms, both animal and plant, which float passively in water. The plankton is especially well-represented in the ocean, but it is not absent from any natural waters. It forms the chief food of fishes.

Although we are concerned here only with living plant-forms, yet mention may be made of the presence in Barbados of thick deposits consisting largely of the fossil remains of certain animal and plant members of plankton known as Radiolaria and Diatomaceae respectively. These deposits occur in the Scotland district and are included in the Chalk of the Oceanic Beds. They go by the names of Barbados Earth, Siliceous Earth, or Diatomaceous Earth. They are of considerable geological interest in that they indicate the great depth at which the Oceanic beds of Barbados must have been deposited, because similar fossil plankton are found on the bed of the present day ocean only at depths below 1,000 fathoms.

The sea which washes the shores of Barbados is rich in plankton, of which the chief plant-forms belong to the families Diatomaceae, Cyanaphyceae (or Blue-green Algae) and Peridinae. It is only by examining sea-water microscopically that the structures of the minute plants can be discerned, but investigation has shown that they are well suited to their habitat, in so far that

their adaptations have developed in two directions;—first, to increase the surface area with the least possible employment of material, and second, to decrease the specific gravity of the organism.

(b) FLOATING HYDROPHYTES OF PONDS.

These include simple filamentous plants belonging to a botanical group known as the Green Algae and also certain peculiar species belonging to the seed-producing plants. In Barbados there are represented only a very few species of true floating Hydrophytes. Of the Green Algae, a common form known as *Spirogyra* occurs in many ponds. Good specimens of this simple plant may be obtained at Graeme Hall in the ditches of the swamp. The appearance of the alga is that of a mass of delicate green threads. The plant is buoyed up by tiny bubbles of gas liberated during vegetative activity. Microscopic investigation reveals the existence of two species of *Spirogyra* in Barbados ponds, the difference between them lying in the form of the spiral band of green substance which is present in the cylindrical cells of their filaments. The chief representative (and as far as is known, the only representative) in Barbados of floating hydrophythic Flowering Plants is the cosmopolitan plant known in England as the Duckweed (*Lemna minor*). This occurs only here and there in Barbados. It may be found growing in the quieter parts of the small watercourse that flows near Three Houses Sugar Factory in the parish of St. Philip.

DESCRIPTION

Lemna minor (Lemnaceae) Duckweed.
(This must not be confused with the xerophytic Duckweed (*Pectis humifusa*) of sandy sea shores).

A small plant, whose green part consists of a tiny, floating green plate (diameter ⅛ inch), which is said to represent the stem, modified so as to function as a leaf. From the under surface of the plate a long root hangs down into the water. The plant reproduces itself chiefly by the detachment from the parent of small branches which grow out from the edge of the green plate. Occasionally tiny, much-reduced flowers are formed, but it is only rarely that seeds develop. The Duckweed is, in fact, a greatly reduced plant which has almost lost the power of reproducing itself by means of seeds. The rapidity with which the plant is propagated by vegetative means, however, enables it, under suitable conditions, rapidly to cover the surface of a pond to which it has gained access.

(2) ANCHORED HYDROPHYTES.

These plants are divided into two classes according as they are anchored to a substratum of rock or to one of soil.

(a) ROCK-ANCHORED HYDROPHYTES.

The most common group of water-plants which are characterised by the habit of growing attached to stones or to anything firm beneath the water's surface are the Algae (Water Mosses) both marine and fresh water.

The *fresh water Algae* are not very common in Barbados. There are only one or two species of rock-anchored forms, and these have not (to the writer's knowledge) been fully investigated. There are few suitable habitats for their development in the ponds of the Island, which may in part explain their scarcity.

The *Marine Algae* (Seaweeds or Sea Mosses) are well represented around the shores of Barbados, and their remains may frequently be seen washed up on sandy beaches. Mention has already been made of this fact in the description of the beach plants of the Maxwell coast of Barbados.

Typical representatives of the marine algae may be seen at low water on the rocky coast of Barbados, particularly near Bath and along other parts of the sea border of the Scotland District. They will here be noticed to be living attached firmly to the rocks. The algal flora of the sea forms a zone round the coast and is only found in certain depths of water. It appears that at about 150 feet below sea level, as a rule, all growth ceases, by reason of the low intensity of light essential to the nutrition of these plants. Hence, exclusive of miscroscopic floating plants of the Plankton, the characteristic flora of the sea is restricted to a comparatively narrow zone lying between high tide mark and some 150 feet below low water. The plants of the algal flora of the sea fall into three large groups which are roughly characterised by their colour as the Green, Brown and Red Seaweeds. These groups are represented by Algae in all parts of the world, and it happens that the colours mentioned run, to a certain extent, parallel with other characteristics of form and propagative methods by which the large groups are more strictly defined. It has been found that the colouring has an important physiological meaning. Green plants make special use of the red rays in sunlight for purposes of nutrition. The rays of other colours (blue, green yellow, &c.) which together constitute light of a greenish tint, they reflect, and it is for this reason that such plants look green. For Brown and Red Seaweeds, rays of a blue colour are especially effective, and it is such rays that penetrate farthest into the depths of the sea water. Thus the colourings have a probable relation to the nutrition of the seaweeds which show them. In particular, the possession of a brown or red tint makes nutrition at great depths possible to those plants which possess them, while it does not appear to be injurious to life at lesser depths. Hence, generally speaking, the Red Seaweeds are more prevalent at the greatest depths, where Brown and Green Seaweeds are less abundantly represented. The Brown Seaweeds extend from the shallowest water downwards, but stop short at the greatest depths. In shallow water all three kinds may be present, and this is observed to be the case near the shores of Barbados.

It is of little interest to know the names of all the seaweeds that might be found near Barbados; indeed they have not all been correctly determined, but it may be worth while to describe one or two of the commonest of them in order to get some idea of the adaptation which these plants show to their environment.

1. *Ulva sp.* (Green Alga) Sea Lettuce. (Leaf-like form).
   The plant body consists of thin, broad, shiny, bright-green expansions of simple outline. It is soft, somewhat slimy and flexible, and is frequently seen in detached masses on sandy beaches. In its natural environment it is attached to rocks by means of disc-like organs called haptera. Because of its strong tough structure, and its smooth slimy surface, Ulva is particularly well adapted for resisting rupture by the beating of the waves. Further, it can also withstand drying up when

lying exposed to sun and wind during periods of low tide by reason of its protective covering, and the slimy layer on its surface.

Many other leaf-like forms of Alga occur in the sea near Barbados along with *Ulva*, but the majority of them are of a brown colour. Of these Brown Algae, *Sargassum*, deserves special note.

2. *Sargassum bacciferum* (Brown Alga) (Leaf-like form).
This is a highly organised seaweed, which shows a differentiation of plant body into leaf-like and stem-like regions. It also possesses clusters of small spherical bladders, which maintain it in an upright and outspread position when living attached to rocks, or keep it floating when it has broken loose from the substratum. Sargassum may thus be carried great distances by means of ocean currents, which fact accounts for its presence in large masses in the Atlantic, especially in the Sargasso Sea where the movement of water is so slight that the seaweed is said to have formed floating meadows.

More common than the leaf-like seaweeds are the filamentous forms, of which every variety of branched and unbranched, slender and tough plant body may be noticed. Certain of them are green Algae but may belong to the Red. The filamentous type gradates into the moss-like form. Of seaweeds of these latter kinds, every conceivable variety occurs, but the majority of them are Red Algae. Finally, the crustaceous type is well represented in the seaweed flora of Barbados. Crustaceous seaweeds have the characteristic habit of secreting calcium carbonate (lime) which forms white masses covering their rounded expansions or branches, and in this way perhaps serving to protect the plant, and to increase its length of life, for it is known that such crustaceous seaweeds are perennial, whereas most of the non-encrusted forms are annual or short-lived.

(b) SOIL-ANCHORED HYDROPHYTES.

This term is meant to imply that certain water plants are anchored to a substratum, which not only serves to fix their position, but also to provide the plants with a certain amount of nutrient material. Associations that are made up of water-plants of this sort include plants of all types, — algae, true mosses, ferns, and flowering plants. We may distinguish in them two groups, which are more or less distinct; hydrophyte associations of brackish water and hydrophyte associations of fresh water. Both groups are well represented in Barbados.

(i) Soil-anchored Hydrophytes of Brackish Water.

This association occurs most typically in Barbados at Graeme Hall swamp, St. Lawrence, but it is there represented by a few plants only, and is not sufficiently free from interference by man to exhibit any particularly striking features. However, a description of the characteristic plants of the Swamp will enable one to understand the adaptations of Hydrophytes of the above group to their environment.

1. *Chara sp.* (Green Alga) Hornwort or Stonewort.
   This is a plant consisting of longish, branched slender stems bearing whorls of narrow leaf-like structures at regular intervals. There are from 5 to 10 leaves at each node, and the length of each is about 1½ inches. The whorls are more closely collected near the end of the stem than elsewhere, and growth is apical. Reproduction is carried on both by vegetative means, and also in a simple way by spores which are formed within bodies attached to the under surfaces of the leaves. The whole plant is held erect by the water, for although its parts are somewhat brittle because of lime in the cell-walls, yet the stems are not provided with strengthening tissue and are unable to keep the plant rigid in air. *Chara* forms dense masses at the bottom of the Swamp, being rooted by a short root system to the muddy substratum.

2. *Ruphia maritima* (Potamogatonaceae) Tassel Pond Weed.
   This is a much-reduced flowering plant whose plant body consists of very long branched, slender, green stems bearing, at intervals of about 2 inches, one or two narrow and much elongated, flattened, hairlike leaves. The whole plant when removed from the water is flaccid and slimy. *Ruphia* is anchored in the muddy substratum by means of a persistent, branched, root-bearing stem system (rhizome), so that it is able to continue growth for several years, and to populate the water with a dense tangle of shoots. *Ruphia* is said to bear tiny flowers at the surface of the water, but these are never produced, to the writer's knowledge, in Graeme Hall Swamp.

Growing amongst the mass of *Chara* and *Ruphia* in Graeme Hall Swamp, certain filamentous, green Algae mentioned above (i.e. *Spirogyra* spp &c.) occur, the total collection of Hydrophytes making up the plant association of this habitat. In conclusion it may be stated that in many regions of the sea near the coast of projecting land masses, it is not unusual to find *Ruphia* and other similar hydrophytic flowering plants, along with certain large Algae (such as *Caulerpa*) growing in luxuriance, and although no typical examples are on record for Barbados, yet near the coast of other West Indies Islands, examples of such a marine association of anchored hydrophytes attached to a loose substratum, have been noted. It is highly probable that the populating of the Swamp at Graeme Hall with *Chara* and *Ruphia* was due in the first place to the encroachment of the sea which carried individuals of these plants from the ocean to the site where they are now found.

(ii) Soil-anchored Hydrophytes of Fresh Water.

This association is the most striking of the Hydrophytic plant associations. It is the common plant association of ponds, and is almost uniform in general features, no matter in what part of the world it is developed.

(iii) General Features of Barbados Ponds.

There are still left in Barbados on certain sugar estates, or in waste places, a few stagnant ponds of small size. These are used chiefly for watering cattle. The largest of them contain water all through the year, and continu-

ously maintain a flora of water-plants. The smaller ponds dry up during the months of March and April, and any plants which are growing in them in the wetter months of the year either die down altogether or, in certain cases, exist in a more or less parched condition until the rain replenishes their habitat with water.

The plants of the larger stagnant ponds often show a marked zonation, that is, at different distances from their margins the vegetation is characterised by different kinds of plants. Thus, along the edge of a typical pond, tall sedges (or rushes) occur, mixed with certain grasses and other plants. In the very shallow water or wet mud near the margin of the pond, dense masses of the Water Hyacinth (*Eichhornia*) occur. Where the water is a little deeper Water Lilies abound. In the deeper water also, one frequently sees plants of the Water Hyacinth floating about entirely unattached to the substratum. Occasionally the small floating Duckweed (*Lemma minor*) forms a bright-green layer on the surface of the water in the centre of the pond, but this plant is not a regular member of the flora of Barbados ponds. Entirely submerged in the deeper water are a few aquatic plants belonging to the Algae. These form tangled masses at the base of the pond or between the stems of the rooted water plants growing from it. The more important of them have already been named, for example, *Spirogyra* and *Chara*.

We are concerned at this place with the plants of the deeper water, for those growing round the edges of the pond belong more properly to a group, known as "Swamp hydrophytes". The hydrophytes now to be described are rooted in the black muddy bottoms of the ponds. They are the Water Hyacinth (*Eichhornia speciosa*) and the Water Lily (*Nymphaea ampla*, &c.)

1. *Eichhornia speciosa* (Pontederiaceae) Water Hyacinth.

This is an introduced plant. Its place of origin is southern U.S.A. It is found in most estate ponds in Barbados, probably having been placed there by planters because of its showy flowers. The leaves are roundish, leathery, and shiny, and of average length 3 to 4 inches. They taper into the stout leaf-stalks which are not markedly swollen in those individuals which live near the pond-margin. The stem is a peculiarly-branching rhizome which is rooted in the mud by means of numerous fibrous roots. The inflorescence is a spike of length about 9 inches. It bears delicate large flowers of a pale bluish-mauve colour. The corolla of each flower has a yellow patch on the inside of its upper part. The leaves of *Eichhornia* frequently completely hide the mud in which the plants grow. Many of them break loose and float into deeper water. The leaf-stalks of these detached individuals become swollen and bladder-like, so that they buoy up the leaves and keep them above the surface of the water. Roots grow out frequently from the bases of the peticles, and these sometimes eventually anchor the plant in the mud. The leaves and leaf-stalks of the Water Hyacinth are plentifully supplied with internal air-spaces, so that the tissues of the plant are well aerated.

2. *Nymphaea ampla* (Nymphaeaceae) Water Lily.

The leaves of this typical water-plant are circular, slightly heart-shaped, and of diameter 3 to 4 inches. They are borne on stout stalks

that arise from rhizomes embedded in mud at the bottom of the pond. These rhizomes can exist for some time even when the pond dries. The young leaves are rolled at first so that thy can easily push aside the older leaves which cover the surface of the water. The leaf-stalks have the power of elongating when the level of the water rises. The floating leaves of the Water Lily are limp and flabby when removed from the water. They are supported by the water when in their natural habitat and, therefore, have no need of stiff stems. The upper leaf-surface is water-proof, being covered with a layer of wax. There are no openings (pores or stomata) in the lower surface, but only in the upper surface, where they are very numerous. In the leaf-stalk, the air-spaces are large. Air-spaces also occur in the rhizomes and in the leaf-blades. Air thus has free access to all parts of the Water-Lily plant. The root system is very small, which is not a drawback since water is very abundant in the substratum in which the plant is anchored. The flowers of the Water-Lily are about 3 inches in diameter. They have numerous petals and stamens. Their colour is white inclined to pink in the centre. The fruit is a woody capsule which splits up into several parts which float away, and eventually become waterlogged and sink to the bottom of the pond where they germinate.

A few other Water Lilies are occasionally found in ponds in Barbados. They have mostly been introduced by man. In certain ponds (e.g.) Hampton estate), the Red-flowered, large-leaved Nelumbium occurs.

(3) SWAMP HYDROPHYTES OF POND MARGINS.

Plants of fresh water swamp associations are rooted in a muddy water-logged substratum, but their leaf-bearing stems are held aloft above the surface. Swamp plants therefore connect true submerged Hydrophytes with Mesophytes, and they show characteristics of each plant-type. For instance, they often possess the aerating system of the former, and the strengthening and conducting tissues and the thick epidermis of the latter. In Barbados, the swamp plants named below occur along the margins of many of the ponds. Of the true grasses (Gramineae) the following genera grow luxuriantly near ponds; *Panicum* spp: *Paspalum* spp: *Leptochloa mucronata; Chloris radiata; Eriochloa punctata; Setaria setosa,* &c. Most of these belong really to the flora of the pasture or field in which the ponds are situated, but their luxuriance causes them to be conspicuous amongst the plants of pond margins. Occasionally, the grasses are rooted in the marshy soil and have their bases covered with water.

Along with grasses, certain other plants occur near marshy pond-margins, chiefly by reason of the abundance of water there. Like the grasses they are not typical swamp plants, and show few features of special interest. As examples the two following plants may be noted.

1. *Commelina nudiflora (Cayennensis)*. (Commelinaceae) Pond Grass.
   (See under "Plants of Cane Fields").

2. *Caperonia castaneifolia* (Euphorbiaceae) Marshy Croton.
   An annual erect herb, of height up to 2 feet. The leaves are narrow

and pointed, and possess well-marked parallel veins. Their margins are dentate. The flower is small, white, and is either male or female. The fruit is a capsule of diameter ¼ inch. Both the stem and the fruit are covered with glandular hairs.

Finally, we come to the true *Swamp Hydrophytes,* of which two typical representatives occur along the borders of ponds in Barbados, and occasionally on the sides of watercourses. They are:—

3. *Jussieua suffraticosa* (Oenotheraceae).

This is an erect plant of height up to 4 feet, with woody base and smooth, dark reddish-brown, angular stems, with many side-branches. The leaves are narrow and pointed, and of average length 2 inches. The flowers are yellow, and possess 4 petals. The diameter of the flower is about 1 inch. The fruit is a 4-celled elongated narrow capsule, containing many small seeds. Its length is about 1½ inches.

4. *Echinodorus rostratus* (=*Alisma cordifolium*) (Monocotyledones) (Alismaceae) Water Plantain.

This plant occurs along the margins of a few of the Barbados ponds. It is rooted in the ground but its leaves are sub-aerial. It possesses underground rhizomes whereby the plant is perennated when the pond dries. The leaves are large, roundish, heart-shaped, and of length 3 inches. They spring up round the base of the plant in a rosette. They have cremulate margins. The flowers are arranged in bunches along the sides and at the end of the tall inflorescence-axis, forming a large loose panicle. The flower is small and white, and possesses 3 petals only. The fruit is a spherical spiny structure, containing one seed.

Much more prevalent than either *Jussieua or Echinodorus* is the Common Rush (*Eleocharis mutatus*) whose green, upright, triangular or round, stiff stems line the sides of most of the ponds of the Island. This plant possesses, however, marked xerophytic features, and belongs really to the next class:—Xerophytic Hydrophytes.

(B) XEROPHYTIC HYDROPHYTES.

Plants belonging to this class, although they are rooted in the waterlogged substratum, yet exhibit xerophytic features in their sub-aerial parts. The reason for this is that either the water of the substratum is so saline that their roots cannot absorb it, or it is so rich in peaty material that it exerts an effect similar to that of salty water.

In Barbados, xerophytic hydrophytes are represented by Sedges and Mangrove plants.

(1) SEDGE-SWAMP PLANTS. (SEDGES).

These are grass-like plants of general tufted habit, which possess sub-aerial parts specially constructed to reduce transpiration. Leaves are absent altogether in the commonest Sedge, their place being taken by stiff green stems. In other

species, the leaves are present, but they are provided with a thick shiny epidermis, and expose a comparatively small surface to the air. Although sedges occur along the marshy borders of many fresh-water ponds, they are most typically developed in the brackish marshy land which occurs in a few localities in Barbados, such as Graeme Hall Swamp.

Along the borders of the water at Graeme Hall Swamp the following sedges occur. (They are erroneously called Rushes locally).

1. *Eleocharis* (=*Scirpus*) *mutatus.* (Cyperaceae) Rush.
   A tall erect plant, whose green triangular stems take the place of leaves of which the plant is devoid. The stems are surmounted by scaly, pale-brownish, spiky inflorescences. Height 1 to 2 feet. The interior of the stems is pithy and contains abundant air-spaces, allowing of free aeration of the submerged parts of the plant and of the root-system situated in the water-logged substratum. A taller sedge, similar to the above (except that its stems are round) occurs frequently, along with the triangular stemmed sedge. Its inner pith consists of narrow plates of tissue traversing the stem from side to side and at small intervals along its length. It is perhaps a variety of the more common triangular sedge described above.

2. *Eleocharis capitata* (Cyperaceae) Grass-Rush.
   A small tuft-like sedge with very numerous wire-like green stems, surmounted by small, brown scaly inflorescences. Leaves are absent. The bases of the stems are red in colour as are also the roots.

3. *Fimbristylis monostachya* (Cyperaceae) Club Rush.
   A grass-like plant with narrow, pointed, wire-like, green leaves of average length 1 foot. The stems each bear a single compact inflorescence of a brown colour near its extremity, and to one side.

4. *Fimbristylis ferruginea* (Cyperaceae) Rusty Club-Rush.
   Similar to the above, but the leaves are longer, and the inflorescence consists of several clusters of rusty-red spikelets of scaly flowers, arranged above two long leaf-like structures that grow out from the stems below them.

There is another swampy region of small extent situated below St. Ann's Fort, near Bridgetown, on the sea coast, and just to the west of the area covered with trees and scrub belonging to the "Coccoloba association" described in detail elsewhere. Here, the chief brackish-water swamp plants are one or two species of sedge (chiefly *Eleocharis monostachya*) along with much rank Binding Grass (*Paspalum distichum*). Similar areas occur here and there near the coast in other parts of Barbados, but they are not worthy of special description.

(2) MANGROVE-SWAMP PLANTS.

At a few localities only do Mangrove swamps occur in Barbados. The two most typical examples are found at Greame Hall Estate, and near the

Bridgetown Railway Station on the river which enters the Careenage. The swamps at these places are doubtless only the remnants of previously extensive marshy regions of brackish water which may have lined the banks of estuaries for a distance of a mile or more inland. Probably at one time Mangrove swamps were of common occurrence along the low-lying shores of the southern and western coast of Barbados. The present day examples afford only a meagre idea of the features of Mangrove vegetation such as form a well-marked plant association along the shores of certain other West Indies Islands and of the mainland of South America.

In Barbados, two trees characterise the Mangrove Swamps. They are the true Mangrove (*Rhizophora*) and the somewhat similar White Mangrove (*Laguncularia*). The latter is by far the commoner in Barbados. In other countries *Rhizophora* is the dominant plant of the association, and many other trees and shrubs besides *Laguncularia* occur along with it. It is even possible to distinguish between an Eastern Mangrove Association (as developed in Africa, Australia, &c.) and a Western Mangrove Association (as seen in America), according to the kinds of xerophytic-hydrophytic woody plants that make up the association.

DESCRIPTION OF THE MANGROVE TREES OF BARBADOS.

1. ***Rhizophora mangle*** (Rhizophorceae) True Mangrove.

A small tree with numerous branches, and with trunk provided with many bow-like prop-roots which radiate on all sides, and help to support the tree. Without these roots the foundation of the plant would not be firm in its muddy substratum. The prop-roots are provided with large air-spaces, which are in communication with the outer air at spongy places in the bark known as lenticels. Thus air can reach the root-system of the plant, which would otherwise be unprovided with air, since the soil in which it is embedded is waterlogged. The leaves of the Mangrove are xerophytic in structure. They possess a thick epidermis, covered with a shiny cuticle. They are leathery, and have few stomata. The plant thus conserves its moisture, an essential protection, since the water at its roots is too saline and peaty to be absorbed by the roots. The seeds of the Mangrove have the extraordinary feature of germinating on the tree. The root of the suspended seedling grows to the shape of an elongated cigar, and, by reason of its weight and sharp extremity, it penetrates the mud at the base of the parent tree when it falls. If the seedling falls into deep water, it floats upright, and may be carried by wind or current to a shallower place where its root tip can reach bottom and strike. This mode of reproduction is well suited to the mode of life of the Mangrove.

2. *Laguncularia racemosa* (Combretaceae) White Mangrove.

This is a small erect tree with many branches. It possesses no prop-roots. The leaves are leathery and shiny, and possess reddish leaf-stalks. The leaves are set edgewise to the sun's rays, which is a further means of checking excessive transpiration. The flowers are small and whitish. They are borne in clusters. The fruit is small and bottle-shaped. It does not germinate on the tree. The stem buds of the

White Mangrove are protected by the thick young leaves being so arranged as to enclose them. They thus lose little moisture by evaporation, and are not exposed to injury by too strong light.

The Olive or Dwarf Mangrove (*Avicennia nitida*) (Verbenaceae) although mentioned by Schomburgk as occurring in Barbados and although common in other West Indies Islands, is not found to the writer's knowledge, in the Mangrove swamps of the Island at the present day.

The three common West Indies Mangrove trees are common to both the Old and the New World. They were doubtless dispersed from Tropical Africa by ocean currents which carried the fruits across the South Atlantic ocean.

SECTION II. THE MIXED PLANT COMMUNITIES OF BARBADOS.

We now come to a consideration of the plant population of districts which offer at one and the same time two or more different sets of conditions for the growth of plants. This results in a mixture of plant types, which on investigation and analysis, proves to be made up of two or more pure associations.

It would be best to arrange the mixed plant communities of Barbados according to the general nature of the habitat. In this way we recognise the plant communities of the following regions.

(A) *Certain waste places.*

(B) *Undercliff regions of the inland terraces.*

CHAPTER XII.

(A) MIXED PLANT COMMUNITIES OF WASTE PLACES.

The waste places included under this heading are districts in which the substratum consists of bare rock with patches of soil or of sand of varying extent interspersed between the exposed rock surfaces. They gradate on the one hand into the habitat of the pure association of "plants of rock-land," and on the other hand, into "dry pasture" or "sandy beach," such as have been described in previous chapters. They may be roughly classified according to the types of vegetation that are represented in their plant population.

(1) WASTE PLACES, THE VEGETATION OF WHICH CONSISTS CHIEFLY OF A MIXTURE OF "SEA BEACH" PLANTS AND "ROCKY LAND" PLANTS.

These regions occur near the sea coast in a few localities of Barbados. The best example occurs along the top of the sea-cliff which borders the southern coast line of the Island in the neighbourhood of Spencers and Seawell estates. The land in this district is quite unfit for cultivation. Rocks jut out all over its surface. Between the rocks, pockets of sandy soil occur. The land continuously receives salt spray from the sea, since the wind blows over it almost incessantly either from the northeast or from intermediate points veering round to the south—according to the season of the year. Thus, the substratum is of such a nature that it favours the growth both of certain rock plants and of plants that can live successfully even in sandy soil containing saline moisture.

The commonest of the typical sea-beach plants occurring on the rocky land are:—

Paspalum distichum (Binding Grass); *Lippia reptans; Pectis humifusa* (Duckweed); *Hippomane mancinella* (Manchineel); *Tecoma leucoxylon* (White Wood) and the succulent halophytes, *Sesuvium portulacastrum* (Seaside samphire) and *Portulaca oleracea* (Purslane).

Of the rock plant type, the commonest plants in this district are:—

Lantana involucrata (White Sage); *Croton flavens* (Seaside Sage); *Cordia cylindristachya* (Black Sage); *Phyllanthus epiphyllanthus* (Sickle-leaved Spurge); *Jatropha gossypifolia* (Belly-ache Bush); and *Opuntia tuna* (Prickly Pear).

It is worthy of mention that in certain of the larger pockets of soil (especially those situated some distance away from the sea) in this strip of rocky land, a few plants, typically belonging to the dry pasture association, occur. The chief of them are:—

Desmodium spp.; Teramnus uncinatus; Rhynchosia minima; along with certain prostrate grasses. These together form a carpet, from which grow a few erect plants such as *Ruellia tuberosa* (Minnie Root); *Sida* spp., &c.

There is another region in Barbados where the vegetation consists essentially of a mixture of certain sandy soil forms and rocky land forms, but which exhibits several special features which make it worthy of mention. The region referred to is the rocky land in the neighbourhood of Chalky Mount in the Scotland District. Chalky Mount is a rugged spur of gritty sandstone, of height above sea-level about 550 feet, which terminates a radial ridge of high land. The Chalky Mount spur runs almost to the sea border, falling rapidly at an angle of about 60 degrees to the shore at a point just over half a mile to the south of Long Pond. The sea-ward parts of Chalky Mount for some distance inland are exposed therefore to the direct blast of the Trade Wind. The wind carries with it saline matter, which may be deposited on such plants as grow on the spur, or on the soil which occurs in pockets on its surface.

The higher regions of Chalky Mount for the most part, are bare and exposed. The gritty rock has been weathered into pinnacles, ledges, hollows and cracks. Here and there, pockets of soil of all sizes and depths occur, and occasionally on the ledges a scanty turf exists on which several grassy and prostrate plants grow successfully. The lower slopes of the Chalky Mount spur are steep and consist chiefly of debris brought down from the higher regions. In certain parts, the talus is in frequent motion, so that few plants can exist on it. In others, however, a firm turf exists which forms rough pasture land for the grazing of sheep and goats. Trees are almost entirely absent.

It is in the pockets and on the ledges of the higher windward parts of Chalky Mount and of the neighbouring elevated land that the vegetation now to be described occurs. This vegetation is on the whole xerophytic. Many shrubby plants already described as characterising certain inland rocky districts of Barbados flourish on Chalky Mount. The commonest of them are:—

Lantana involucrata and *camara; Cordia cylindristachya; Croton flavens* (Sages); *Psidium guajava* (Guava); *Phyllanthus epiphyllanthus* (Sickle-leaved Spurge); *Jatropha gossypifolia* (Belly-ache Bush); and *Opuntia tuna* (Prickly Pear). Besides these, other typical xerophytes (such as the large rare Cactus (*Cephalocerus* sp. nov:) with its thick, erect, spiny and occasionally-branched green stems; and the tall massive-leaved *Agave americana* (Century plant or Maypole Bush) occur.

Along with these rocky-cliff plants, several other shrubby xerophytes abound. Of them, the following have already been described or mentioned amongst the plants of sandy tracts near the sea shore. *Coccoloba uvifera* (Seaside Grape); *Tecoma leucoxylon* (White Wood), *Clerodendron aculeatum* (Wild Coffee) and *Stachytarpheta indica* (Vervain). In the shallower pockets of sandy soil, and forming scanty turf here and there on the rocky ledges, are certain grasses, such as *Paspalum distichum* (Binding Grass); *Cenchrus echinatus* (Burr Grass); *Cynodon dactylon* (Devil's Grass); *Sporobolus indicus* (Wire Grass); and the prostrate plants *Ipomaea biloba* (Goat's-foot); *Lippia reptans* and *Pectis humifusa*. In the more sheltered places, the succulent plants *Heliotropium curassavicum* (Wild Lavender); *Sesuvium portulacastrum* (Samphire); *Portulaca oleracea* (Purslane); and *Iresine* (=*Philoxerus*) *portulacoides* also occur. Finally, two shrubby xerophytes, especially characteristic of this region, deserve mention. They are *Chrysobalanus icaco* (Fat Pork) and *Ecastaphyllum brownei* (a leguminous plant).

The conspicuous presence on Chalky Mount of the second series of halophytic plants named above, occurring as they do along with rocky-land plants, and their absence on the hill ranges further inland, points to the conclusion that they inhabit this region because of the peculiar conditions which prevail there. The peculiarity implied may be the salinity of the soil and air of the windward parts of Chalky Mount,—a conclusion favoured by the fact that many of these plants occur on or near the sea shore, or on moist rocks bordering the sea in other parts of Barbados. Their presence in the vegetation of the high waste land is the striking feature of the plant-community of Chalky Mount.

(2) WASTE PLACES, THE VEGETATION OF WHICH CONSISTS CHIEFLY OF A MIXTURE OF "ROCKY-LAND" PLANTS AND "DRY-PASTURE" PLANTS.

These regions are far more common than the last. They constitute the bulk of the uncultivated land of the inland coralline regions of Barbados. They are well represented in the south and south-east of the Island along the summit of the line of inland cliffs that runs parallel to the coast at a distance varying between half and one mile from the sea border. The height of these cliffs varies from 50 to 150 feet. Waste places of this description also occur on sugar estates in the middle of the Island, especially near the rocky edges of terraces. They embrace, according to the definition, any waste land which is too irregular and rocky to deserve the title of "dry pasture." Their vegetation includes most of the rock-plants already mentioned, and almost all these plants that characterise dry pastures, especially those that form carpets, such as certain grasses, leguminous prostrate plants, and prostrate plants of other families. The carpets occur in hollows or pockets between the bare rocks, and the groups of plants represented in each may vary somewhat from place to place.

It is not unusual to find considerable areas of land in these rocky places covered with fairly luxuriant Sour Grass, the uniformity of which, however, is broken by clumps of rock plants growing near those places where the bare rock is exposed. More commonly, the grassy herbage includes several genera, such as *Cynodon; Sporobolus; Panicum; Paspalum; Chloris*, &c., the development of which is typically prostrate and stunted.

CHAPTER XIII.

(B) THE MIXED PLANT COMMUNITIES OF UNDERCLIFF REGIONS.

The inland cliffs which form a characteristic feature of the coralline region of Barbados have already been mentioned in connection with the topography of the Island. The faces of many of these cliffs are more or less hidden by vegetation consisting chiefly of small trees and shrubs, sufficiently distinctive to deserve special mention; it may be regarded as a plant community of fairly definite composition. An analysis of this vegetation reveals the presence of many plants characteristic of rocky land, mixed with certain plants more fitted for life under moister conditions. Hence the plant community of the undercliff regions may be considered as a mixed vegetation of rocky land plants and plants of an almost mesophytic type.

The district where the undercliff plants are best developed is perhaps the southern part of Barbados, especially beneath the first terrace which runs more or less parallel to the coast of the parish of Christ Church and of the adjoining part of Saint Philip.

The reasons why the vegetation is so characteristic in undercliff regions are two in number. First of all, it has been left undisturbed by man, and therefore stands out clearly from the vegetation of the cultivated land around. Secondly, the substratum in which the more mesophytic plants are rooted is fairly deep (consisting of soil collected in pockets between the bare rock masses, or situated on talus slopes at the cliff-bases), and is provided with an almost regular supply of moisture, because of the proximity of the lime-stone cliff which provides seepage water.

The plants of the undercliff vegetation of the first inland escarpment as represented in the southern coastal region of Barbados at the cliffs below Seawell and Spencers Estates (Christ Church), include the following common forms:—

(1) **ROCKY LAND PLANTS** (growing where the sub-stratum is rocky, and where true soil is scarce).

All the plants mentioned and described under the heading "Rocky land plants" (which constitutes a xerophytic, pure plant association) are to be found in abundance in this locality.

(2) **MESOPHYTIC PLANTS** (growing in the pockets of soil between the rock masses, and on the talus slopes at the bases of the cliffs).

These are chiefly shrubs which occur occasionally in certain pure plant associations already described, but which more commonly are found growing in undercliff regions. The chief of them are the shrubby trees or shrubs. White Wood (*Tecoma leucoxylon*); Bread and Cheese (*Pithecolobium unguis-cati*); Fustic; Manchineel; Seaside Grape; Wild Coffee; Bearded Fig (*Ficus laurifolia*), (whose occurrence here is of special interest); Trigonette (*Ixora parviflora*); Pica Bush (botanical name not known); and the liane Soldier Bush (*Tournefortia volubilis*). A few creeping or trailing plants grow over the rock surface or over the stems and branches of the bushy plants. The commonest of them are—the Poison Withe (or Scratch Withe) (*Vitis sicyoides*); and the blue-flowered Convolvulus (*Jacquemontia pentantha*). Occasionally, certain more rare creepers are found. One is a slender, wiry plant which possesses small, opposite leaves, occurring in pairs at regular intervals along the stem, and which gives a milky juice on being bruised. It is a species of *Metastelma* (Asclepiadaceae). Another, is a slender woody scrambler, which produces winged fruits, each consisting of two easily separated parts. The fruits remind one of the Keys of the Maple or the Ash of temperate countries. The name of this mesophytic creeper is *Securidaca volubilis* (Polygalaceae).

DIVISION B—PLANTS OF BARBADOS WHOSE DISTRIBUTION IS LARGELY INFLUENCED BY MAN.

SECTION I.—ARTIFICIAL PLANT ASSOCIATIONS.

In this section it is intended to consider plants which are associated together in habitats whose growth conditions are being constantly influenced or have in the past been influenced, consciously or unconsciously, by human agency. The plant associations belonging to this category, in a sense, are therefore "artificial". It must be clearly understood, however, that it is by purely natural means that the plants constituting the associations gain access to the habitats which they occupy, and that the reason why certain plants only come thus to be associated together, is entirely owing to the fact that these plants happen to be suited to the prevailing conditions of growth, whereas other plants are not so suited.

The artificial plant associations of Barbados occur in the following regions:—

(1) *Cane-fields,*

(2) *Permanent "pastures" (meadows) of Sour Grass, &c.,*

(3) *Certain waste places,*

(4) *Certain waysides.*

Each region will be considered in turn, and it will be indicated in each subsection how far man has influenced the vegetation of the several habitats.

CHAPTER XIV.

(1) PLANTS OF CANE-FIELDS: (CANE-FIELD WEEDS.)

When the soil of Barbados was first prepared for the growth of crops, the early planters had to remove and destroy the native plants. The freshly-made soil thus laid bare has since been much altered by ploughing, draining and manuring, but all the time its surface has been exposed to invasion by native plants which escaped destruction. These plants have spread from gullies, roadsides, waste places, &c., their seeds being transported to the new habitat by various agents of dispersal, the chief of which is wind. Unless great care is taken to eradicate them, the invaders will occupy the soil intended for the crops, and, being sturdier and stronger, will soon gain mastery. From the planter's point of view, they are plants in the wrong place, and he calls them "weeds". It is only by the constant effort of gangs of labourers (or farmers), sent out almost every day into the cane-fields (so long as the size of the canes will allow of free working) that the weeds are kept in check.

A botanical investigation of cane-field weeds considered in relation to the peculiar conditions that prevail on cultivated soil in Barbados enables one to understand why certain kinds of plants persistently make their appearance, whereas others are never found on cane-lands. At the outset, the method of cultivation of the sugar-cane must be stated, as this is one of the most important factors. In Barbados, plant canes are grown chiefly from pieces of stem ("joints" of cane), and in certain districts (such as the red soil districts of the uplands), ratooning is practised to some extent. The date of planting a new crop of plant canes from cuttings is usually about November, i.e., towards the end of the rainy season. The plants require about 18 months to reach maturity, so that the time of reaping lies in the months of March to July in the year but one after that in which the canes were planted.

It is possible and customary to weed cane-fields in Barbados up to the end of the seventh month after the date of planting. The operation is made troublesome, however, by the presence of "trash" (i.e., dry cane leaves) which is spread over the ground at the expiration of three or four months from the time of planting, to prevent excessive loss of soil moisture. At the trashing period (January to March), plant-canes are generally about one to two feet tall, and have reached the critical period in their growth, since dry weather prevails in these months and danger from drought is not inconsiderable. It is a matter of some surprise that in Barbados young cane plants can successfully live through the dry season, especially during certain years in which the rainfall is abnormally low. The explanation of the fact might more reasonably be sought in the peculiar condition of the sub-soil and of the underlying spongy and porous coral-rock (which undoubtedly store up much water in the rainy season, and yield it up again by capillarity in the dry season), than in the drought-resisting propensities of the cane plant. No doubt, also, the occasional showers that fall during January and February assist the cane plants in tiding over the dry season.

Manuring with artificial manures is carried out in Barbados at the commencement of the rainy season (in April to June). Soon after this date, the canes are of such a height that efficient weeding becomes impossible.

From the above account it is clear that, so far as the weeds are concerned, the vegetative season in a Barbados cane-field consists of two distinct periods:—

(A) *the first*,—extending from the date of the planting of the canes (in November) up to the time when the land can no longer be weeded (i.e., up to July of the next year);—a period of about eight months' duration;

(B) *the second*,—extending from the end of the weeding time to the date of reaping of the canes (in March to July);—a period of 9 to 12 months' duration.

(A) CANE-FIELD WEEDS OF THE FIRST PERIOD.

During this period the weeds are exposed to an oft repeated turning over of the surface soil, and to frequent mutilation by the hoe of the weeder. It is not surprising, therefore, that only few plants of a certain kind can survive

such drastic treatment, and can become sufficiently well established between the visits of the weeder to make themselves conspicuous on cane-fields. As an offset to this hindrance to growth, one must bear in mind that the soil of cane-fields during the first period is in good condition and is "open", i.e., it is not occupied by the root-systems of well-grown plants as it is when the canes are mature. It is also unshaded by the stems and leaves of well-grown cane-plants.

A study of the characteristic features of the weeds in the appended list will indicate why these plants are able to persist in cane-fields:—

(i) In the first place all of them are prostrate herbs which are enabled to survive in the very earliest stages of their growth (when their root systems are still of small extent), because their leaves are spread close to the ground where the air is moister, and also partly perhaps because of their shading effect on the surface soil immediately below them, which minimises the removal by evaporation of moisture from the shallow surface-layer in which the soil roots are embedded.

(ii) Secondly, the weeds are quick-growers especially as regards their root-systems. They are mostly annual plants and reach their flowering periods in the space of a few months or even a few weeks.

(iii) Thirdly, many of them possess underground parts which can never be completely removed from the soil, and which are capable of giving rise to new shoots by a process of budding. Frequently, the sub-aerial stems themselves if broken off and left in the soil can take root and produce new plants.

(iv) Finally, all the weeds possess efficient and rapid means of dispersal, usually by wind. They can thus gain access to the freshly exposed soil of new cane-lands.

The following are the chief weeds of cane-fields during the first period:—

1. *Cyperus rotundus* (Cyperaceae) "Nut Grass."

This is perhaps the most pernicious and most prevalent cane-field weed in Barbados. It is said to have been introduced into the Island (and into other West Indian Islands) by human agency. It is a prostrate grass-like plant with quick and deep-growing, fibrous, underground stems (rhizomes), which bear numerous small tubers. This habit accounts for the success of the Nut Grass in cane-fields, since weeding only removes the green part of the plant, and leaves most of the underground parts in the soil. These latter may be inverted by the hoe, but soon the tubers bud out, and quickly produce new green shoots again. The Nut Grass has erect triangular stems (of height up to 10 inches) and flat leaves. The inflorescence consists of a cluster of spreading flattened spikelets of unequal length. The seeds are very small and wind-disseminated. They may serve in the rapid distribution of the plant over cane-fields during favourable weather.

2. Certain true grasses (Gramineae), such as:—
Cynodon dactylon, Devil's Grass, Bahama Grass.
Panicum prostratum
Panicum colonum, Palister grass.
Chloris radiata
Andropogon pertusus (=*Amphilophis intermedia* var. *acida*) Sour grass.
Bouteloua bromoides, Bird Grass.

Most of these prostrate grasses have already been described under "Plants of dry pastures." They have similar habits of growth, and reproduce themselves chiefly by underground rhizomes, which are very difficult to remove, and which are only turned over during weeding and not destroyed.

The seeds are small and wind-disseminated, and doubtless distribute the grass-species over wide areas.

3. *Commelina nudiflora* (=*cayennensis*) (Commelinaceae) Pond Grass.
This is not a true grass. It bears small flowers with bright-blue petals. The stem is creeping, slender, soft and green. It bears occasional roots at the nodes. The leaves are small (1 or 2 inches long, by ½ to 1 inch broad), and possess sheathing, tubular leaf-bases. The fruit is a small capsule of three chambers with 1 or 2 seeds in each. The Pond-Grass is a very pernicious weed in the cane-fields of the more rainy upland districts of Barbados, but it is not so common in dry lands. It is a quick grower, and is reproduced probably both by pieces of stems and by seeds.

4. *Euphorbia prostrata* (Euphorbiaceae) Milkweed. Poverty Weed.
A small prostrate plant, consisting of several slender stems arranged radially round the top of a very long main root. The stems bear small roundish leaves pressed close to the ground, and also numerous tiny flowers, which give rise to capsules containing seeds. The stems and leaves are reddish in one variety. (Reedweed) and green in another (less common) variety. The Milkweed is a very quick grower, especially as regards its root system, and, by producing large numbers of microscopic wind-disseminated seeds, it multiplies rapidly in cultivated ground, which offers little resistance to the downward growth of its roots.

5. *Euphorbia hypericifolia* (Euphorbiaceae) Milkweed.
Similar to the above, but not quite prostrate. The more or less erect stems grow to a height of 2 feet. The leaves are larger than those of *E. prostrata*, and the small flowers are arranged chiefly in terminal bunches.

6. *Pectis humifusa*. (Compositae) Duckweed.
Occurs also on the sea-shore. A prostrate mat plant with long main root, fairly common in dry sandy cane-fields. It possesses small hairy fruits.

7. *Portulaca oleracea* (Portulacaceae) Purslane.
A prostrate plant, already described. (See "Plants of dry pastures"). The broad-leaved form is common in cane-fields, especially when the soil is dry and sandy. It is chiefly disseminated by its tiny seeds.

8. *Tribulus maximus*. (Zygophyllaceae).
A prostrate plant which is perhaps more frequently seen in neglected gardens than in cane-fields. It possesses several stems which radiate from the summit of a deep-rooted tap root. The stems are pinkish in colour, and may grow to a great length. The leaves are bipinnate, consisting usually of 3 pairs of leaflets of length ½ inch. The flowers are pale yellow, cup-shaped, and of diameter ½ inch. The fruit splits into 4 to 6 parts when ripe.

9. *Rhynchosia minima*. (Leguminoseae,—Papilionatae) Burn-mouth Vine.
A small prostrate leguminous weed. Common also on dry pastures.

10. *Ipomaea dissecta*. (Convolvulaceae).
A twining plant (already described under "Mesophytes of gullies") which frequently trails on the ground when no support is available. It is not a very common weed on cane lands, but is occasionally found in moist places.

A few other weeds make their appearance in cane-fields as seedlings. They are usually easily removed, although several individuals always escape the observation of the weeders and continue to exist so as to become characteristic weeds of the second period of growth to be described next.

(B) CANE-FIELD WEEDS OF THE SECOND PERIOD.

During this period, the weeds are undisturbed in the soil, since weeding can no longer be performed because of the large size of the cane plants. The presence of well-developed canes, however, at the same time, places certain restrictions on the vegetative activity of the weeds of cane-fields during the second period. These restrictions counteract the advantage which the weeds enjoy over those of cane-fields subjected to the hoe of the weeder. For instance, the soil of the fields is fully occupied by the abundant roots of the cane plant which, being surface-feeding and wide-spreading, makes it almost impossible for all but a few plants to produce their normal root development. Further, the tall cane plants cut off much light from those weeds which are growing in their vicinity. They also alter other atmospheric conditions of growth, in that they shelter the weeds from wind. The result of this is that the air near the soil in fields of mature canes is humid and quiet;—factors which exert their effects in deciding what kinds of plants will eventually constitute the weed flora of mature cane-fields.

It should be borne in mind that the number of individual plants that may survive the persistent weeding of the first period is bound to be small. Further, only those survivors possessing certain characteristics are able to succeed in competition with the vigorous cane plant.

The prostrate plants which have been able to tide over the first period, will most probably be exteriminated by the "smothering" effect of the rapidly growing canes, and of the dead leaves (trash) which cover the soil during the second period.

The plants included in the following list should therefore be studied from the point of view of the effect of these various factors.

(i) In the first place, the weeds in the list are chiefly climbing plants belonging to the family Leguminoseae. They make use of the cane plants in spreading their leaves to the subdued light which occurs within the dense tangle of leaves and stems of closely growing mature canes. Their stems are weak and exhibit long internodes.

(ii) Secondly, they possess leaves admirably suited for the peculiar conditions of their habitat. The leaves are large and thin, and are not protected for resisting the harmful effects of intense light, or for checking rapid transpiration. There would be no advantage in such protection, since the light reaching the leaves is diffused and of low intensity, and since the environment is such that evaporation is minimised and water supply abundant. In short, the climbing weeds of fields of mature canes are typical shade plants. Specimens collected when the canes are being cut show great luxuriance of growth.

(iii) A few erect herbs which are not climbers occasionally survive the exacting conditions of growth in mature cane-fields. These also have large thin leaves, but are usually lanky, because of the effect of light of small intensity.

(iv). Most of the weeds possess extensive root-systems consisting of a long tap-root, with numerous branching roots that ramify between the fibrous roots of the canes.

The following are the chief weeds of cane-fields during the second period:—

(a) **CLIMBERS.** (Leguminoseae—Papilionatae).

1. *Teramnus labialis.* (similar to *T. uncinatus*), Rabbit Vine.

   (See under "Plants of dry pastures"). The plants of this species found in mature cane-fields grow luxuriantly and develop the twining habit typically. Their leaves are larger than the stunted related species of dry pastures. The vines often reach great length, and the flowers and fruits are produced in profusion.

2. *Phaseolus semierectus.* Wild Dolly, Kidney Bean.
   An annual plant with stems erect at the base, and twining above. The leaves are trifoliate. Each of the three leaflets is ovate, and of length about 2 inches. The leaves are thin, bright green, and covered with fine silky hairs. The flowers are borne in long racemes with a much elongated stalk to the inflorescence. The flower is deep purple in colour. The fruit is a narrow curved legume of length about 4 inches, containing often as many as 20 small seeds.

3. *Vigna glabra* (=*luteola*), Yellow Vigna, Rouncival Bean, Monkey Pea.
A plant similar in habit to the above and possessing similar leaves. The flowers are of a bright yellow colour. The fruit is a narrow legume of length about 2 inches and contains about 10 small pale-brown seeds.

4. *Mucuna pruriens.* Cow-itch.
An annual twiner, with slender hairy stems and trifoliate leaves. The leaflets are ovate, and are often 3 inches or more in length. They are thin and slightly hairy. The flowers are borne in short racemes in the axils of the leaves. The fruits occur in clusters. They are hard yellow-brown pods, covered with a dense layer of hairs, which are intensely irritating when they break off and penetrate the skin of animals. The pod is oblong, of length 2 inches, and shaped somewhat like a letter S.

(b) ERECT HERBS.

It is very unusual to find specimens of erect herbaceous weeds in cane-fields. Those individuals that survive the period of weeding are generally quickly suppressed by the vigorously growing cane plants. Occasionally, when the canes are being cut, one might come across a specimen of some erect herb, which usually shows lanky or otherwise abnormal growth. Such weeds can be recognized as escapes from the plant community that inhabits the waysides of roads and paths near the canefields. The commonest amongst them are hardy, quick growing, rapidly-disseminated annual plants such as certain Compositae, Labiatae and Verbenaceae. They will be described or mentioned when the plants of waysides are considered.

CHAPTER XV.

(2) PLANTS OF PERMANENT PASTURES. (MEADOW WEEDS)

In the chapter on the Mesophytic Associations of Barbados, an account was given of the pure plant association of the dry pastures, and, as a preface to that account, mention was made of the existence in the Island of numerous permanent pastures, (which should more strictly be termed meadows), in which the chief grass is either Sour Grass, Guinea Grass or Para Grass. It is now intended to consider the vegetation of these pastures in turn, beginning with Sour Grass pastures which constitute the main pastures of Barbados.

(A) PERMANENT PASTURES (MEADOWS) OF SOUR GRASS.

Most sugar estates of Barbados possess one or more fields which were originally planted in Sour Grass, but which have rarely or never been manured since the original planting. The planting was done in the first place by spreading short pieces of Sour Grass stems over ground which had in most cases previously been under sugar cane cultivation, and then covering the pieces with a thin layer of soil. As will be gathered from its past history, the soil of Sour Grass fields is, therefore, frequently of considerable depth, and by reason of its previous tillage and manuring, it is more retentive of water than soil of uncultivated districts.

Sour Grass is generally cut twice or three times during the year, and animals are seldom, if ever, allowed to graze on it whilst it is growing. Hence the Barbados Sour Grass pasture might more correctly be termed an unmanured Sour Grass meadow, and might thus be compared with certain meadows of temperate regions such as Europe and North America.

It is a noticeable fact in the Barbados Sour Grass pastures, that, in spite of neglect, the vegetation is surprisingly pure. The number of weeds that occur along with the Sour Grass is exceedingly small;—a state of affairs which can be obtained in meadows of temperate countries only by rigorous and systematic weeding, and by the employment of the purest manures.

The appearance of a field of Barbados Sour Grass is very uniform. The colour, in mass effect, is a bright yellowish-green, except when the grass is in flower, when the dark-red inflorescences naturally affect the general tint. The freshness of the Sour Grass fields is a characteristic of the landscape of the flatter parts of the Island. It is difficult to explain convincingly why Barbados Sour Grass pastures are so pure and free from weeds. The chief reason is perhaps the vigorous growth of the grass, which makes it almost impossible for other plants successfully to compete with it.

DESCRIPTION OF THE BARBADOS SOUR GRASS.

(*Andropogon pertusus=Amphilophis intermedia* var: *acida* sp. nov: Stapf, 1916) (See under "Food plants").

The Sour Grass is a perennial plant, growing to a height of 2½ feet. The underground part of the plant is a short rhizome, which bears numerous adventitious roots. The subaerial stems are tufted, and are usually more or less prostrate at the base. The prostrate part of the stems generally gives off rootlets at the nodes. The leaves possess short sheathing bases, and fairly long linear blades, (of length 3 to 8 inches and breadth ⅛ to ¼ inch). They are almost quite smooth. The inflorescence is a panicle, consisting of a primary axis (of length up to 3 inches), which bears several (10 to 15) horizontal racemes of spikelets of flowers.

WEEDS OF SOUR GRASS PASTURES.

There are two conspicuous weeds which occur persistently in Barbados Sour Grass pastures. They are:—

1. *Crotalaria retusa.* (Leguminoseae,—Papilionatae), Yellow Sweet-pea. An erect plant, with woody stem bases. The plant grows up to height of 2 feet, and usually possesses many branches. The leaves are single and spatulate in shape, green and smooth above, and whitish and downy beneath. The inflorescence is a many flowered raceme, the papilionaceous yellow flowers being about 1 inch long. The fruit is a cylindrical black dehiscent pod, 1½ inches long, containing numerous small, kidney-shaped seeds, which shake about loose in the pod before dehiscence. The plant is very common throughout the West Indies. In Barbados it is commonest in those Sour Grass fields which occur in the lowland black soil districts.

2. *Cassia polyadena.* (Leguminoseae—Papilionatae). Wild Tamarind. A perennial plant, woody, erect, but possessing few branches. Height up to 2 feet. The leaves are pinnate, with 4 to 8 leaflets, each of length about ¾ inch, and breadth ⅜ inch. The flowers are yellow, and of length 1 inch. They are borne singly or in pairs in the leaf-axils. The fruit is a narrow, thin, dark-brown, dehiscent pod of length 1 inch. The Wild Tamarind characterises the Sour Grass fields of the red soil (upland) districts of Barbados, rather than those of the black soil (lowland) regions.

The reason why these two weeds are able to compete with the vigorous Sour Grass, whereas few other wild plants are ever successful is difficult to understand. The seeds of both weeds germinate easily and the tap roots of the seedlings are abnormally long and quick-growing. These characteristics might allow rooting in the layers of soil below those occupied by the shallower rooted grass, thus preventing competition. It must be admitted, however, that there are many other weeds in Barbados (along waysides etc.) which also possess the root-characteristics exhibited by *Crotalaria* and by *Cassia polyadena,* but which are nevertheless rarely seen growing in Sour Grass fields.

Other weeds of Sour Grass fields of much less importance than the above and of infrequent occurrence, are the leguminous, erect plant, *Desmanthus depressus* (along with a few other erect plants, already mentioned or described under the heading "Dry pastures"), and certain procumbent or prostrate leguminous plants, such as *Teramnus uncinatus* (Rabbit Vine),; *Desmodium* spp. (Sweethearts); *Rhynchosia minima* (Burn-mouth Vine), which also belong to the flora of dry pastures.

(B) PERMANENT PASTURES (MEADOWS) OF GUINEA GRASS.

There are a few unmanured meadows here and there in Barbados in which the chief grass is Guinea Grass (*Panicum maximum*). Many of these meadows occur in or near Bridgetown, and occasionally on the sugar estates of the Scotland District along the sides of water courses. Guinea Grass meadows are never extensive in Barbados. They are usually small plots of grass grown for fodder for horses chiefly. They exhibit one or two features of botanical interest worthy of brief consideration.

DESCRIPTION OF GUINEA GRASS.

Panicum maximum—(See under "Food plants").

A perennial grass of tufted habit, growing up to a height of 2 to 5 feet. (It is stated that, under cultivation, Guinea Grass may reach a height of 12 feet, but, although this height may be attained in other Antillean Islands, it is never attained by Barbados Guinea Grass. The stem is erect, stout and straight. There is a short underground rhizome. The inflorescence is a loose panicle of length 4 to 12 inches. Inflorescences are produced prolifically in the wet season.

WEEDS OF GUINEA GRASS PASTURES (MEADOWS).

These consist of small prostrate herbs, climbing herbs and erect herbs. The small prostrate herbs and the erect herbs, include many of the species found in dry pastures. It is to be noticed that the weeds of Guinea Grass plots include few or no grasses. The erect herbs are mostly woody, as in the case of dry pastures.

The chief feature of the weed flora of Guinea Grass pastures is the presence in them of numerous, slender climbing plants, which twist by means of tendrils up the tall stems of the grass, or of the erect weeds.

The chief of them are:—

1. *Passiflora foetida* (Passifloraceae) Love-in-a-mist.

   Climbs by auxilalry stem-tendril.

2. *Peponia* Sp. (Cucurbitaceae). Wild Cucumber.
   Climbs by means of tendrils, of which the true nature is not clear.

3. *Ipomea pentaphylla.* (Convolvulaceae).

Climbs by twisting round its support. The leaves of this plant are 5-lobed. The stems and leaf-petioles are covered with long yellow hairs. The funnel-shaped flowers are white.

These climbers occur also in gullies and are more fully described under "Mesophytes of gullies."

(C) PERMANENT PASTURES (MEADOWS) OF PARA GRASS.

These are of less frequent occurrence in Barbados even than Guinea Grass meadows. Para Grass grows properly only in well-watered situations, and is found almost exclusively in the upland districts of Barbados, in bottoms or hollows where water tends to accumulate, and where soil cultivation for cane-growing is difficult. Para Grass is also fairly common near water courses in the Scotland District estates.

DESCRIPTION OF PARA GRASS.

Panicum muticum—(see under "Food Plants").

A perennial tufted grass, which, unlike Guinea Grass, possesses a more or less prostrate habit. The underground rhizome is short, and the stem bases are frequently rooted at the nodes. The inflorescence is similar to that of Guinea Grass.

WEEDS OF PARA GRASS PASTURES (MEADOWS).

These are not numerous nor of especial interest. A certain number of weeds which grow best in moist soil are able successfully to compete with Para Grass. Examples are:—*Spigelia anthelmia* (Water Weed), and a few other erect herbs:—*Commelina nudiflora* (Pond Grass), and certain other prostrate plants, (including leguminous creepers), and occasionally sedges such as *Cyperus rotundus* (Nut Grass), together with other *Cyperus* species, and species of *Fimbristylis.*

CHAPTER XVI.

(3) PLANTS OF CERTAIN WASTE PLACES.

Besides the natural waste places already considered in Chapter XII, there are other waste places in Barbados where the conditions of plant growth have been somewhat influenced by man.

In many parts of Barbados where coral limestone is being quarried for use in building, lime-manufacture or road-making, or where marl is being removed for agricultural or other purposes, the exposed substratum quickly becomes populated with vegetation of a fairly well-marked type. Vegetation of a similar nature is also found growing on debris heaped up near building sites, or near places where excavations or levelling operations are, or have been, going on.

The conditions of growth in such habitats are sufficiently distinctive as to prohibit the establishment of all but a few species of plants, at least in the early stages of colonisation. The substratum itself is highly calcareous, and contains an extremely small amount of organic matter. The water supply varies. Usually, because of the porous and retentive nature of the coral material, it is quite good. The soil water is generally fairly rich in nutrient salts. These characteristics of very chalky soil considered along with other incompletely understood physical and chemical properties, seem to satisfy the requirements of plants of a certain type. In many countries of the world, plants that thrive vigorously on chalky soil have been investigated, and lists of their names compiled. Many true chalk or limestone plants are thus known to botanical science, and it is possible that the plants to be named below might also belong to this class.

It will be noticed that the plants possess few obviously similar and distinctive characteristics, except perhaps that they are all quick growers, and produce great numbers of small seeds. This latter characteristic might have value in ensuring that a good number of the seeds at least reach situations favourable for germination.

The chief plants growing commonly in old quarries, marl pits, and on chalky debris in Barbados are:—

1. *Argemone mexicana.* (Papaveraceae). Mexican Thistle, Yellow Poppy.

An erect annual herb of height about 2 feet, having greyish wax-covered leaves and stems. The plant contains yellow bitter juice. The leaves are deeply divided, and possess numerous spiny teeth. They have conspicuous whitish leaf-veins. The flower is large and yellow; its petals are thin and drop easily. The fruit is an erect capsule which, when dry, allows its seeds to be sprinkled out through holes near its summit as the wind shakes the plant. *Argemone* is not indigenous to Barbados, but was introduced into the West Indies inadvertently along

with seeds of cultivated crops, from Mexico. It is a common weed, not only of chalky ground, but also of certain dry pastures and neglected cultivated peasant-plots in all parts of the Island. It is found on waste-lands in all tropical countries.

2. *Leonotis nepetaefolia* (Labiatae) Lion's Tail.

A common erect annual herb. It is a very quick-growing plant, with a deep tap-root system. The stems are square, and of height up to 3 feet. The leaves are large, oval, crenulate and possess long petioles when mature, so that the young leaves do not shade the old. The most conspicuous part of the plant is its straight inflorescence axis, which bears several globular clusters of flowers or fruits with spiny calyces at distances of 6 inches to 1 inch apart. The flowers protrude from the younger green clusters. They are two-lipped, and orange in colour. The fruits are brown, membranous and very spiny. They contain each several small black seeds. *Leonotis* is a common weed of ubiquitous occurrence in Barbados.

3. *Boerhavia hirsuta* (=*repens*) (Nyctaginaceae). Hogweed.

A loosely-branched herb of height 2 feet, with somewhat trailing, long slender stems, which are dark coloured and slightly hairy. The leaves are more or less oval, and of length about 1 inch. The flowers are tiny, of a blood-red colour, and are arranged in panicles. The fruit is a small club-shaped capsule of length ⅛ to ¼ inch. It is covered with glandular hairs, which cause it to adhere to animals. The Hogweed is also common in dry pastures.

4. *Achyranthes aspera.* (Amarantaceae)

A herb with woody base and low branches. The leaves are elliptical, pointed, and of length 1½ to 3½ inches. The flowers are very tiny, and are arranged along a lengthy slender axis. The flowers soon give rise to small dry fruits (length ⅛ inch), which possess each four backwardly-directed spines. The spinose fruits are easily disseminated by animals and passers-by. *Achyranthes* is a common erect plant of dry pastures.

5. *Gynandropsis* (*cleome*) *pentaphylla.* (Capparidaceae). Stinking Miss.

An erect annual herb, of height up to 3 feet. The leaves consist each of five elliptical leaflets attached to the end of the leaf-stalk. The flowers are arranged in terminal leafy racemes. Each flower has 4 small white petals and 4 stamens arranged at the end of a slender stalk. The ovary also is borne on a special stalk. The fruit is a narrow dry capsule of length 2 inches. It dehisces by 2 valves, and leaves the small seeds attached to a frame work from which they eventually drop to the ground. The crushed leaves emit a disagreeable odour.

6. *Lepidium virginicum.* (Cruciferae). Wild Cress, Pepper Grass.

An erect annual herb of height up to 1½ feet. It is much branched above,—the branches terminating in floral racemes. The leaves are narrow, and of length up to 3 inches. The flowers are very tiny, and possess each 4 white petals. The fruits are flattened, dry, heart-shaped structures, of length ⅛ inch. They are very numerous, and form the most conspicuous feature of the plant.

Besides the above, certain other less typical plants, many of which have already been described or mentioned, occur in recently exposed chalky localities, or on heaps of debris. The chief are:—*Cenchrus echinatus* (Burr Grass); *Eragrostis ciliaris* and *E. purshii* (tufted grasses); many members of the family Compositae, and a few hardy plants of other families.

As the substratum becomes disintegrated by weathering, and as the addition of the dead remains of the first-established plants gives rise to true humus-containing soil, the waste places gradually become able to support a more varied and luxuriant flora. Perennial plants begin to appear, and finally certain shrubs and trees. The following plants have been observed to populate such mature sites. *Jatropha gossypifolia* (Belly-ache Bush); *Clerodendron aculeatum* (Wild Coffee); *Tribulus maximus* (a woody prostrate herb of the family Zygophyllaceae); *Sida* spp; *Capraria biflora; Waltheria americana* (Buff Coat); many grasses; certain creepers, such as *Momordica charantia* (Cucurbitaceae); *Cardiospermum halicacabum*, (the last two already described under "Climbing herbs of gullies"), and the shrubby trees *Leucaena glauca* (Mimosoideae); *Pithecolobium unguis-cati* (Bread-and-cheese); and *Zizyphus jujuba* (Dunk).

CHAPTER XVII.

(4) PLANTS OF CERTAIN WAYSIDES.

The vegetation of the waysides of Barbados at first sight would appear to be particularly uninteresting, but their botanical investigation, in the light of foregoing considerations, reveals endless ecological problems.

The waysides of Barbados may be divided into several groups, as follows:—

A. Waysides of the main high roads skirting cane-fields in the coralline parts of Barbados.

B. Waysides that consist of an almost vertical rocky wall.

C. Roads and paths separating cane-fields (including also roads of the Scotland District).

D. Waysides of the streets of Bridgetown, and of the larger villages.

These groups merge imperceptibly into one another in places, but, on the whole, they are fairly well-defined. The manner in which man has been instrumental in determining the nature of the wayside flora, has already been described in Chapter VII. It was there concluded that the habitats of certain wayside plants of Barbados owe several of their features (such as depth and nature of the sub-stratum, position as regards light and exposure to interference by animals and man), to the fact that they owe their origin to human agency. The relative importance of man's influence as an agent governing the distribution of plants in the habitats offered by the different types of wayside will be made clear when each type is considered.

(A) WAYSIDES OF HIGH ROADS IN THE CORALLINE PARTS OF BARBADOS.

The high roads of the coralline region of Barbados are numerous, and, on the whole, well-kept. They are bordered for the most part by cane-fields, and probably owe their frequently tortuous course to the fact that they were originally built to skirt the cane-fields. It is a noticeable feature that most of the high roads are sunk below the level of the cane lands on either side. This is probably due to the wear and tear of their surfaces, and to the rolling they have received during repair. The roadside thus consists typically of a bank of height usually one to four feet, which generally has a gutter or trench at its base.

We may consider first the vegetation of the wayside bank, and afterwards, that of the gutter.

(1) THE WAYSIDE BANK.

The bank is usually rocky and very irregular. It is often almost vertical, seldom inclined at an angle of less than 45 degrees. Here and there bare rock protrudes, but in the hollows, pockets and crevices soil occurs in sufficient quantity to support a fairly prolific vegetation.

The soil is usually cane-field soil, which has fallen down from the cultivated land above. It is thus rich in organic matter and in nutrient salts, and is in good tilth. Further, because of its position, the soil of the bank is well drained. The surface of the bank is generally exposed to the sun's rays, since shrubs are usually absent from its summit, and the cane-plants on the land above are only tall enough to give much shade for a small part of the vegetative season. In the deeper pockets of soil, the water supply may be fairly abundant, by reason of the gradual passage into it of water stored in the porous and retentive coral rock, which comprises the foundation of the bank. The depth of the soil varies, therefore, from place to place on wayside banks, and the vegetation varies accordingly in their different regions.

Growing in the shallower pockets of soil, and almost on bare rock itself, one finds rocky land xerophytes such as the Sages (*Lantana involucrata, L. camara, Cordia cylindristachya* and *Croton flavens*) ; *Psidium guajava* (Guava) ; *Jatropha gossypifolia* (Belly-ache Bush) ; *Pedilanthus tithymaloides* (Laurel-leaved Spurge) ; &c.

The deeper pockets support a grassy flora, which is often rank and vigorous. The grass most commonly present is the Sour Grass (*Amphilophis intermedia*, var : *acida*), although other perennial grasses, such as the Devil's Grass (*Cynodon dactylon*) and, occasionally, annual grasses also occur. Along with the grasses, several erect perennial herbs abound. The chief of these are *Stachytarpheta indica* (Vervain) ; *Cassia polyadena* (Wild Tamarind) ; *Crotalaria spp.* (Sweet Peas) ; *Desmanthus depressus; Blechum Brownei; Corchorus siliqulosus* and *Miconia laevigata.* Frequently erect annuals occur also,—*Euphorbia* spp. (Spurges) ; *Spermacoce* (=*Borrera*) *laevis;* and certain Compositae and Labiatae may also be cited as examples. Finally, several creeping or climbing plants grow amongst the grasses and the erect herbs, or sprawl over the bank. The commonest are—*Wedelia gracilis* (Compositae—a prostrate creeper) ; *Vitis sicyoides* (Poison Withe) ; *Ipomea spp.* and *Passiflora foetida* (Love-in-a-mist).

From the above account, it might be concluded that the flora of typical roadside banks approximates closely to a mixture of certain xerophytic rocky land-plant types and certain dry pasture types. In so far as it consists chiefly of perennial plants which are well-established in the sub-stratum, the bank flora certainly does resemble such a mixture of associations.

The chief characteristic is the relative luxuriance of the growth of the perennials, grasses and other herbs as compared with those of typical dry pastures;—a fact partly to be explained by the more abundant water supply of wayside bank-habitats, and partly by the general absence of the check to growth imposed on vegetation subjected to the attacks of grazing animals.

(2) THE WAYSIDE GUTTER OR TRENCH (AT THE BASE OF THE BANK).

The plants growing here differ markedly from those of the bank since the conditions of growth in the two regions are very dissimilar. In the first place, the sub-stratum of gutters is not composed of good soil in most cases, but of a mixture of soil which has fallen down from the bank above and road dust, &c., which has collected in the gutters especially during windy weather. The soil is not usually very deep, and its water supply is intermittent. In the rainy months, the gutter may contain abundant moisture, and plants might thrive luxuriantly in it. On the other hand, in the dry season, the gutters are parched and dusty, and the plants are often almost completely desiccated. A still more important factor is the repeated extermination and mutilation to which the gutter-plants are subjected by the hoes of weeders. These weeders are sent out by the Highways Boards Authorities almost every day, and every high road in the Island is supposed to be cleared of gutter-plants at least twice a year.

It is thus evident that the conditions of life of plants that start growth in wayside gutters or trenches are very precarious. Nevertheless, a certain number of plants manage to succeed in spite of difficulties. Their characters are well worthy of investigation.

At the outset one notices a resemblance between the set of factors that operate in wayside gutters and those that operate in cane-fields during the first period of growth when the fields are being weeded. One would, therefore, expect to find the same sort of plants inhabiting gutters (especially just after they have been cleaned) as appear on weeded open cane-lands. Observation shows this actually to be the case. The prostrate plants already described under "Plants of cane-fields" frequently occur in wayside gutters. Indeed, they are the first to make their appearance there. Later, other annual plants become established, but perennials seldom appear, since their growth is, generally speaking, slow, and they are not allowed sufficient time between the weeding periods in which to produce seeds. Thus the characteristic plant community of wayside gutters is composed chiefly of quick-growing annual herbs, which possess ready means of spreading.

In addition to the plants listed under the heading "Cane field weeds of the first period" which include several grasses and prostrate plants (especially *Euphorbia* spp.), the following species are commonly found in wayside gutters. They mostly belong to the family Compositae, a family which, perhaps, represents the high-water mark of efficiency in adaptation to various habitats, and in rapidity of seed dispersal.

Compositae.

1. *Vernonia cinerea.*

An erect, much branched, deep-rooted, annual plant, growing up to a height of one to two feet. It possesses oval leaves and pale-lilac flowers arranged in small close heads. The tiny fruits are furnished with white hairy parachutes, which aid in their dispersal by wind.

2. *Parthenium hysterophorus* Whitehead.
An erect much-branched, deep-rooted annual plant with small dissected leaves, and very numerous small white pentagonal heads of flowers. Its fruits are small, and are either devoid of hairs or possess only few of them.

3. *Emilia sonchifolia.* Red Groundsel, Paint Brush.
An erect, deep-rooted annual plant with fairly large, irregular arrow-shaped leaves which clasp the stems at their bases. The heads of flowers are pale-red in colour, and the small fruits are provided with parachutes of hairs.

4. *Eclipta alba.*
Similar to the above in habit, but possessing dark-green stems and leaves, and green, disc-like heads of flowers. The fruits are tiny, but devoid of hairs.

Other species of Compositae occur occasionally in wayside gutters. The chief are:—

Erigeron spathulatus and *E. canadensis* (which have parachute-like, hairy fruits); *Lagascea mollis* (Velvet Bush) and *Ageratum conyzoides* (which have bare fruits); *Elephantopus spicatus; Synedrella nodiflora* (Porter Bush) and *Bidens pilosa* (having spiny fruits which adhere to the legs of animals).

The following quick-maturing annual plants with rapid means of seed dispersal, also commonly occur in gutters, especially when these are moist or shady, and are left undisturbed for some time:—

Fleurya aestuans (Nettle); *Amaranthus viridis* (Pig Weed); *Priva echinata* (Velvet Burr); *Heliotropium indicum* (White Clary); *H. parviflorum* (Eyebright); *H. curassavicum* (Wild Lavender); *Euphorbia pilulifera; E. lassiocarpa* (Spurges); *Ocimum micranthum* (Wild Basil); *Hyptis capitata* (Wild Hops); *Leonurus sibiricus* (Siberian Motherwort); *Spigelia anthelmia* (Water Weed); *Spermacoce* (=*Borrera*) *laevis; Chenopodium ambrosiode*s (Wormwood); *Portulaca oleracea* (Purslane); and *Isotoma longiflora* (Star of Bethlehem).

Finally, when wayside gutters are left undisturbed, and never cleared of weeds, they gradually fill and their vegetation slowly changes to that of a more or less dry pasture type, with a preponderance of perennial plants. These perennial plants oust the annuals from the habitat because they possess more effective methods of vegetative propagation, and are able to tide over periods of drought by means of their persistent underground parts or their resistant woody stem bases.

(B) WAYSIDES WHICH CONSIST OF AN ALMOST VERTICAL ROCKY WALL.

Two fairly distinct kinds of rocky walls bordering roads of Barbados may be recognised—

(1) Rocky walls which have been produced artificially by cutting roads through terraces (in order to reduce the steepness of the road surfaces) in the limestone districts of the Island. Usually both sides of the road are bordered by cliffs of this sort.

(2) Rocky walls which have existed naturally from the earliest times, and alongside of which roads have been constructed so as to skirt them. Usually only one side of the road is bordered by such cliffs. The two kinds may be considered separately.

(1) ARTIFICIAL ROADSIDE ROCKY WALLS.

In the last section the commonest kind of waysides in the coralline parts of Barbados was considered. The waysides of that type were described as consisting of rocky banks with gutters, ditches or trenches at their bases, and it was assumed that they had been formed by the gradual wearing down of the road surface by traffic, so that the cane-lands on either side now stand at a level on the average of about 4 feet above the road surface.

In certain places, the roads have been cut through terraces of all sizes and steepness, so that the roadsides here consist of almost vertical walls whose height varies from a few feet to 30 feet or more. Being of comparatively recent origin, the faces of these walls have not usually undergone much weathering, so that they are not very deeply pitted. There are thus few sites on the actual rock-face suitable for the establishment of a definite flora. Further, many of them are exposed to the sun and wind so that moisture conditions are poor. Occasionally ledges occur at different levels on the cliffs. These sometimes support a vegetation of xerophytic plants of a type very similar to that found on certain inland rocky cliffs, and sometimes also of other plants, such as grasses. The summit of the walls generally presents a similar habitat as the ledges, and here also xerophytic and other plants often occur. These plants gradually merge into the plants of the fields or waste land at the top of the roadside cliff.

At the bases of many of the rocky walls, shallow ditches or hollows occur. These have either been worn out by water during periods of heavy rainfall, or have been dug by the road makers for the purpose of drainage. In either case they support a flora which resembles in every respect that already described in the last section.

It is common to find certain characteristic plants growing out from the lower parts of the walls of roadside cuttings. The chief of them are described below. They seem to require fairly abundant water in order to flourish properly. This they apparently find in the damp rock at the bases of walls. They occasionally occur also at the bases of walls of old buildings, in certain parts of gullies, or inside the shafts of wells or "sucks" of cane-fields. The lower parts of most artificial roadside walls are damper than the higher parts of the

wall, by reason of the tendency of the moisture which accumulates in the spongy porous coral rock to percolate vertically downwards from the upper layers which lie immediately below the soil of the land above, and then to spread laterally, until it oozes out somewhere near the level of the road. Perhaps also the fact that water remains for some time in contact with the basal parts of the roadside walls during the wet months (when the gutters contain much rain-water), permits of the soaking up of moisture by the spongy coral rock in the vicinity of the gutters, thus causing the lower layers of rock to be permanently damper than the upper layers.

The commonest of the plants which grow prevalently on the moister rock near the base of many road cuttings are:—

1. *Pteris longifolia* (Polypodiaceae-Filicineae). Common Wall-fern.
   The fronds of this fern are of length ½ to 2 feet. They consist each of numerous lateral leaflets, and terminate in a long leaflet, which forms a conspicuous feature of the frond. Each leaflet is of length 2 to 6 inches, and width ⅛ to ½ inch. The apex is pointed, and the margin is slightly curled (except near the apex) to protect the numerous sporangia that line the edges of the leaflet. The base of the leaf-stalk is clothed with pale-brown scaly hairs. The root-system consists of fibrous roots that grow out from a small disc-like structure to which the fronds are attached. These roots firmly attach the plant to the rocky wall.

2. *Isotoma longifolia* (Campanulaceae) Star of Bethlehem.
   A poisonous herb. Biennial or triennial. The leaves are 3 to 4 inches long, lanceolate and deeply indented. They form tufts round the short rarely-branched stem. The flowers are long, narrow and tubular, with flat, white, 5-rayed summits. Their length is about 4 inches, and the diameter of the "star" is 1 inch. The plant flowers for most of the year.

4. *Pilea microphylla* (=*muscosa*). (Euphorbiaceae).
   A delicate pale-green plant with very small and numerous leaves, and spreading freely-branched stems.

Besides the above, certain ferns (other than *Pteris*) occasionally occur on the lower parts of the walls. The dampness and shadiness of the walls decide whether or not these ferns are able to thrive. The same species as those already described in connection with the flora of gullies are sometimes represented. *Gymnogramme calamelanos* (Silver-backed Fern) is the commonest of them. Frequently also certain succulent creepers of gullies, (especially *Peperomia pelucida*), grow on the walls when conditions are favourable. Dark green-brown velvety tufts of true Mosses also often times occur. *Funaria* sp. is the commonest of these. Finally, patches of silver-grey, yellow-brown and pale-green Lichens mottle the walls of road cuttings in all their parts, and produce a conspicuous colouration.

(2) NATURAL ROADSIDE ROCKY WALLS.

These are often of considerable height. They may not immediately border the road but may be situated some distance away from it, the intervening ground

being of the nature of dry pasture or rocky waste land. The rocky walls may in certain cases merely form the sides of large detached masses of coral rock which have fallen down from neighbouring cliffs, and which have proved too big to be removed, so that the roads or paths have had to be made round them. Usually their surfaces have undergone much weathering, and deep pits or pockets occur all over them. In those districts where the rocky walls are somewhat sheltered from winds, and where the water supply is fairly good, the vegetation frequently reaches luxuriance. The pockets in the walls support the life of epiphytes, succulents and rock plants similar in assortment to those of a typical gully wall. The soil at the base of the wall is sufficiently deep and rich to support several species of climbing plants, which grow in tangled masses over the epiphytes and erect plants that are rooted on the vertical rock-face. On the basal soil grow also many erect shrubs and herbs frequently seen on the floors of gullies. Occasionally, however, the rocky faces of many road-bordering cliffs are so exposed that they are, for the most part, bare of vegetation.

(C) ROADS AND PATHS SEPARATING CANE FIELDS.

Cane-fields in Barbados are separated at frequent intervals by roads and paths which are used during manuring, reaping, &c. for the conveyance of materials or canes from or to the estate yard, and for providing easy access to the fields. The paths are not always in constant use, so that their vegetation is allowed to grow unmolested for some time.

Cane-field paths are generally rough and stony. They are green with grass and herbage. The sides of the path slope up to the cane-fields on each side, so that there is an earthy bank of exposed cane-field soil, on which many plants flourish during those times of the year when the canes are maturing, and when weeding is not being practised.

It would be advisable, therefore, to consider cane-field paths as consisting of two different regions:—

(1) The central part of the path traversed by carts, cattle, labourers, &c.

(2) The earthy banks bordering the paths.

(1) THE CENTRAL REGION OF CANE-FIELD PATHS.

This region consists usually of stony ground. The rocks of the substratum often appear through the soil, the soil varying in depth from place to place in the path, and for that reason presenting habitats of different degrees of favourableness for the growth of plants.

The vegetation of the central region of cane-field paths would thus be expected to exhibit the same features as that of rocky waste places. Examination proves this to be the case, with one qualification, and that is that the cane-field path vegetation, although consisting of the same kinds of plants, is far more luxuriant than that of rocky waste places. The explanation of this lies in the fact that firstly, the paths are much more protected from wind than most waste places, and secondly, that the pockets of soil are generally deeper and moister than those of waste places. One frequently finds in the central regions of cane-

field paths certain xerophytic rock plants such as *Lantana spp.; Cordia cylindristachya; Croton flavens* (Sages); *Psidium guajava* (Guava); *Jatropha gossypifolia* (Bellyache Bush); *Pluchea odorata* (Cure-for-all); which grow in the shallower pockets. Intermingled with these are perennial grasses, perennial herbs and a few shrubs, together with certain annual grasses and herbs which grow in the deeper soil.

Of the perennial grasses, the Sour Grass is by far the commonest in cane-field paths. It frequently grows rank and thick in patches of considerable size, especially in those paths which are seldom used, and in which the grass has had time thoroughly to establish itself. Other perennial tufted grasses such as *Sporobolus indicus* (Wire Grass); species of *Paspalum* and of *Panicum,* and in the drier places, *Cynodon dactylon* (Devils Grass) also often occur.

The most conspicuous of the perennial herbs represented in the central regions of cane-field paths other than the rock xerophytes already mentioned are:—*Stachytarpheta indica* (Vervain) and the woody-based rigid Composite plant, *Elephantopus spicatus* (Spiked Elephant's Foot). Other perennial herbs of common occurrences are—*Cassia polyadena* (Wild Tamarind); *Crotalaria retusa* and *verrucosa* (Sweet Peas); *Desmanthus depressus; Corchorus siliqulosus* (Broom Weed); *Sida* spp.; *Blechum brownei* and *Waltheria americana* (Buff Coat).

Prostrate plants are not typically developed, since the conditions in the pockets of the soil are not, generally speaking, like those of the soil of close-cropped and almost parched dry pastures. Such plants as *Desmodium* spp. (Sweethearts); *Teramnus uncinatus* (Rabbit Vine) and *Stylosanthes procumbens,* whose stunted, low-lying stems constitute a carpet over the soil of typical Barbados dry pastures, are here seen to take on a more profuse growth, and in certain cases, to exhibit the climbing or sprawling habit of which they are capable when growing under favourable conditions.

Finally, annual plants occur in greater or less profusion. These include a few species of grasses; many species of Compositae, and also members of other families, such as Euphorbiaceae, Leguminoseae, Labiatae and Verbenaceae.

(2) THE EARTHY BANKS BORDERING CANE-FIELD PATHS.

The region of a typical cane-field path implied under this heading is actually part of the cane-field itself. It is the very edge of the field, and it marks the limit of cultivation. It runs along the heads and the sides of the cane-rows, and gradually merges at the base of its slope into the central regions of the cane paths.

The soil factors as regards depth, moisture, tilth, &c. are practically the same for the banks bordering a cane-field as for the cane-field itself. Also, the restrictions placed in the growth of weeds by the activities of weeders during the first period in cane cultivation, are the same for both regions; for the weeders clear the banks of weeds at the same time as they clear the fields.

The chief point of difference between the two habitats is that in the very interior of a field of mature canes the light is of such low intensity and the cane

plants are so closely grown, that few weeds (except certain creepers which use the cane stems as a means of support) are able to thrive. On the banks, however, the light conditions are favourable to the growth of plants of all kinds.

The above considerations lead one to expect firstly, that the plant population of the banks bordering cane-fields would consist chiefly of annual plants, for perennials would have insufficient time to establish themselves properly. Secondly, one would expect to find a great *variety* of species growing on the cane-field banks, since seeds of many kinds of plants growing in the cane-field paths, along the sides of high roads, in gullies and in waste places in the vicinity of the cane-fields, could easily be carried to the soil bordering the fields, and would there find favourable conditions for germination. Those plants possessing the most efficient means of dispersal would perhaps be expected to be represented in the greatest numbers, since such plants would arrive first on the newly exposed ground. Finally, any plant which when once established, is able to multiply rapidly, either by producing large numbers of seeds in a very short time, or by possessing ready means of vegetative reproduction, would be expected to become a conspicuous species in the cane-field bank flora.

The above predictions are borne out by actual observation. Firstly, annuals predominate on the banks of cane-fields. They include most of those already named in previous sections. Secondly, the first annual plants to colonise the banks are those possessing dispersal-mechanisms which will allow of wide-spread and rapid dissemination. They include those species which form the weed-flora of cane-lands in the early stages of cane growth, whose names have already been given. Especial mention might here be made again of members of the Compositae which enter into this first period weed-flora. These possess wind-borne fruits provided with hairy parachutes. Well-grown specimens of *Emilia sonchifolio* (Red Groundsel) ; *Sonchus oleraceus* (Sow Thistle, a yellow-flowered weed, which was in all probability inadvertently introduced by man into Barbados from Europe) : *Erigeron canadensis* and *Erigeron spathulatus* (Flea Banes) frequently occur on cane-field banks, and by reason of their wind-borne hairy fruits, are amongst their first colonisers. Besides these, *Parthenium hysterophorus* (White Head) ; *Eclipta alba; Lagascea mollis* (Velvet Bush) and *Agaratum conyzoides*—Compositae with small but hairless wind-borne fruits, are also common. Other conspicuous annual weeds, which mature later on cane-field banks, include various members of the family Leguminoseae, (*Teramnus uncinatus* (Rabbit Vine) ; *Phaseolus semierectus* (Wild Dolly) ; *Vigna luteola* (Yellow Vigna or Rouncival) ; *Mucuna pruriens* (Cow-Itch) &c.,—weeds which are able to thrive also in the very interior of cane-fields, where they climb up the cane stems.

Amongst the perennials which reach their flowering stage just before the canes are reaped from the fields whose pathway banks they inhabit, *Stachytarpheta indica* (Vervain) ; *Crotalaria retusa* and *verrucosa* (Sweet Peas) and *Cassia polyadena* (Wild Tamarind) may specially be noted.

Finally, the following quick-growing annuals frequently occur at the edges of cane-fields, especially in the south-eastern part of Barbados.

1. *Physalis pubescens* (Solanaceae) Pops.
   An erect, annual, herbaceous plant (height about 1 foot), of luxuriant growth. The leaves are simple, ovate, of length about 2 inches, and breadth 1 inch. The branches are repeatedly forked, and in each angle a flower (or fruit) is borne. The flower is small, lemon-yellow, with purple throat and purple anthers. The fruit is a berry of diameter ½ inch, enclosed in the angular bladder-like calyx, of length ¾ inch. It may be dispersed by birds but it frequently dries up and liberates its tiny seeds, which may be carried by wind.

2. *Physalis linkiana* (Solanaceae) Pops.
   Very similar to the above, but distinguished from it by its rounder fruit-bladders, and its slightly hairy stems and leaves.

3. *Physalis minima* (Solanaceae) Pops.
   Possesses smaller leaves and flowers than *P. pubescens* and is hairy. The anthers are yellow not purple.

4. *Phyllanthus niruri* (Euphorbiaceae).
   An erect annual herb of height up to 1½ feet. The leaves are small, thin, arranged in pairs on opposite sides of the stems, pale-green and roundish in shape. Each leaf bears a small flower in its axil. The fruit is a tiny capsule containing a few minute seeds.

(3) ROADS OF THE SCOTLAND DISTRICT.

The roads of the Scotland District of Barbados, being less used than those of the coralline parts of the Island, and being built on a softer substratum of crumbly sandstone and clay, do not exhibit the same features as the high roads of the coral regions. The Scotland District roads, for instance, do not possess steep rocky banks so characteristic of the much-used limestone roads of the coralline regions of Barbados, nor do they ever lie in deep cuttings hewn through solid rock. They are, however, bordered in most cases by cane-fields, and, on the whole they may be compared with those almost unkept paths which divide the cane-lands in the coralline part of the Island. They may, therefore, be conveniently included under the same heading as those cane-field paths.

The more important Scotland District roads are bare and hard except near their margins, where they gradually merge into the cane-lands either sloping gently to the level of the fields, or sinking slightly into shallow gutters lying immediately along the edges of the fields.

The flora of the waysides of these roads is very much like that of the earthy banks of the paths through the cane-fields of the coralline regions already described. The conditions of growth, and the factors governing the colonisation of the soil of these Scotland waysides, are almost identical with those in operation in the cane-field wayside banks of the other districts. One finds growing on them a great variety of annual weeds; along with certain perennial plants such as *Stachytarpheta indica* (Vervain); *Cassia polyadena* (Wild Tamarind); and the two species of *Crotalaria* (Sweet Peas), which grow sufficiently quickly as to produce flowers in a comparatively short space of time.

(D) WAYSIDES OF THE STREETS OF BRIDGETOWN AND OF THE LARGER VILLAGES OF BARBADOS.

Most of the streets of Bridgetown are bordered by more or less shallow gutters, which carry off rain water during wet weather into drains which lead to the sea. In many cases the gutters are constructed of tiles or slabs of stone, and occasionally of concrete. Usually they are simply hollows in the ground along the street sides. They present the same conditions of growth as do the gutters at the bases of the rocky roadside banks of the highways of the coralline parts of Barbados. The factors governing the growth of plants in them need not again be considered.

The commonest plant found in street gutters is *Cynodon dactylon* (Devil's Grass). This plant is the most difficult of all to eradicate since the hoe of the weeder can seldom uproot its underground stems. It appears in newly cleaned gutters even in the driest weather within a fortnight after the weeders have passed on. Another common gutter weed is *Parthenium hysterophorous* (Whitehead). This plant produces such large numbers of tiny fruits in so short a time, that its seeds can never be removed even from the scanty soil of gutters. *Vernonia cinera* (Compositae) is also common in street gutters. It is easily spread by means of its hairy fruits.

Besides the above, perennial grasses such as *Sporobolus indicus* (Wire Grass),; *Paspalum conjugatum; Panicum prostratum; Eleusine indica* and *aegyptica;*—annual grasses such as *Chloris radiata; Eragrostis purshii* and *pilosa;* and *Leptochloa mucronata* occur commonly in gutters, but their abundance varies greatly with moisture conditions.

Annual herbs are frequently found in different stages of growth in street gutters. The rapidly growing *Amaranthus viridis* (Pigweed) and the tooth-leaved Nettle (*Fleurya aestuans*) are especially common where a fair amount of soil has collected, and *Euphorbia hypericifolia,* along with other species of *Euphorbia,* are almost always found. Many other annual plants make their appearance in wet weather in the more neglected gutters, their abundance also being decided by local conditions.

SECTION II.—PLANTS ARRANGED IN NO ECOLOGICAL GROUPING.

In this last section it is intended to describe the more common plants of Barbados which occur in no ecological groups, but which are found growing in habitats that have in most cases, been chosen or prepared for them. Most of these plants are introduced plants, and it is interesting to note their places of origin, so that one may become impressed by the fact that the most conspicuous part of the present-day vegetation of Barbados consists of exotic species derived from many different countries.

The plants of this class may be considered under five heads:—

(1) *Shade trees.*

(2) *Trees with showy flowers, or otherwise ornamental.*

(3) *Fruit trees.*

(4) *Garden plants.*

(5) *Food plants* (other than fruit trees).

CHAPTER XVIII.

(1) THE SHADE TREES OF BARBADOS.

These trees are arranged below in their approximate order of commonness. The specimens are found growing near dwelling houses, along roadsides, in estate yards, and here and there in or near cane-fields. Most of them are introduced plants. In the lists, where no special mention is made of the origin of a tree, it is to be assumed that the tree has been introduced by man into Barbados. Indigenous trees are described as such.

1. *Swietenia mahagoni* (Meliaceae) Mahogany.
   A tall deciduous tree with numerous pinnate leaves each with six to ten pairs of small pointed leaflets. The flowers are very small, and are borne in panicles. The fruit is a large, erect, pear-shaped capsule. It has a thick, woody pericarp, which breaks explosively in five segments when dry. The seeds are winged. The tree sheds its leaves in April and May. Before dropping, the leaves display autumnal tints of yellow, brown and red. When the tree is almost bare the fruits begin to dehisce, and the new leaves to sprout (in June and July). The flowers are produced at the same time. The mahogany is grown chiefly in gardens, groves and occasionally along roadsides. The tree was introduced into Barbados between 1780 and 1800. It is a native of Honduras.

2. *Tamarindus indica* (Leguminoseae-Caesalpinoideae). Tamarind.
   A tall tree, very much branched, with numerous pendulous, pinnate leaves, each with ten to eighteen pairs of small oblong leaflets. The flowers are arranged in racemose clusters. They are small and odorous,

and are protected in the bud by loosely-attached pink bracts. The fruit is an indehiscent legume, cylindrical in shape, and slightly curved; length—about four inches. It has a fragile brown pericarp and contains one to eight seeds embedded in sticky brown pulp. The Tamarind flowers in June and July and its fruits are ripe in March to May. The fruits are exported from the Island in considerable quantities. The tree is partly deciduous, shedding some of its leaves in the dry season. Most gardens possess at least one Tamarind tree. The tree is a native of the East Indies, and was first planted in Barbados in 1650 or thereabouts. It is an established fact that the Tamarind was introduced by the Spaniards into Mexico, and it may thus have been imported from there into Barbados.

3. *Ficus nitida* (=*aurea?*) (Moraceae). Evergreen.
A comparatively low tree with wide-spreading, horizontal branches. These branches are thick, and are in most cases unsupported by props. The underground root system is very extensive. Hanging roots are not numerous. The leaves are small (usually about one and a half inches long), green, leathery, elliptical, smooth, and almost obtuse at the apices. The "figs" are borne in pairs in the leaf-axils. They are sessile and look like peas. Each has two or three small bracts at the base and a small mouth closed by scales. The Evergreen frequently grows near managers' houses on sugar estates, where it forms shade sufficient for saddle horses and often for many estate animals also. The tree was introduced into Barbados before 1750. It is a native of India.

4. *Tecoma leucoxylon* (Bignoniaceae). White Wood.
A more or less evergreen tree of medium height. The branches are not very wide-spreading. The leaves are compound, consisting of three (and sometimes more, up to eight) smooth, rigid, oval leaflets. The length of a leaflet is about three inches. The flowers are funnel-shaped, of length two and a half inches and pink in colour. The fruit is a long pod-like capsule—of length six to eight inches, which splits into two valves, and liberates the numerous two-winged seeds. The White Wood flowers most prolifically in the dry season, when also many of its leaves fall to the ground. The tree commonly forms groves, especially on land and along roadsides near the sea. It is a South American and West Indian tree, and is probably indigenous to Barbados.

5. *Hura crepitans* (Euphorbiaceae). Sand-box.
A large, symmetrical, much-branched tree, with stout trunk and strong limbs. It is deciduous, although it rarely sheds all its leaves at once. Generally the leaves drop gradually as the dry season proceeds, and at the end of an unusually severe period of drought, few of them remain on the tree. The bark of the Sand-box is thick, and is covered with short, sharp prickles. The leaves are more or less heart-shaped, and of length about four inches and breadth three inches. The leaves and twigs exude a milky juice when bruised. The flowers are unisexual; there are female flowers and male flowers borne separately on one and the same tree. They are produced most abundantly at the beginning of the wet season. The fruit is a many chambered capsule, which dehisces

explosively when dry into segments, and thus liberates the flat seeds. The woody fruit-covering, with the seeds extracted, was in former times used as a sand sprinkler in lieu of blotting paper—hence the name "Sand-box". Filled with lead, the fruit forms a handy paper weight. The Sand-box tree is commonly grown in gardens and along the roadsides in all parts of Barbados. It is probably an indigenous plant.

6. *Oreodoxa oleracea* (Palmae). Cabbage Palm.
This well-known palm often reaches a height of 100 feet. Its trunk is straight and of diameter three to five feet. The outer covering is slightly ribbed but is otherwise smooth. The upper part of the trunk for a distance of about twenty feet is covered by the sheathing green leaf-bases of the outer leaves of the crown. The leaves are large and compound (pinnate). The bud in the centre of the crown is sometimes eaten as a vegetable.—hence the name "Cabbage Palm." The flowers are borne in a much-branched and profuse inflorescence which, when young, is enclosed in a large, leathery bract (spathe). This bract falls off when the fruits begin to ripen. The fruit is a small berry of diameter three-quarter inch. The Cabbage Palm is indigenous to Barbados. It is commonly seen along roadsides and avenues.

7. *Casuarina equisetifolia* (Casuarinaceae). Casuarina, Mile Tree.
A tall, quick-growing tree, with slender branches and rugged bark. The older branches are drooping. The younger are relatively short, and clothe the elongated main stem in such a way as to form a graceful, conical spire, frequently reaching upwards to a height of 150 feet. This spire waves to and fro in the wind. The ultimate twigs of the tree are green, of length eight to ten inches, and are each composed of thirty to thirty-five segments. The segments are finely ribbed, and where they join, a ring of tiny teeth-like leaves occurs. The flowers are unisexual, the male flowers being arranged in terminal spikes, and the female in stalked spherical heads. The fruit is woody, and not unlike a small fir-cone. The seeds are winged, and are protected until shed between the woody scales of the fruit. The root system is very extensive, so that few plants can live near a well-established Casuarina tree. The features of the tree indicate that it is a true xerophyte, being able to withstand drought very successfully. The Casuarina originated in North Australia, or the Indian Archipelago, and was probably introduced into Barbados about 1870. It is frequently grown together with the Cabbage Palm along roadsides, and forms a conspicuous feature in the landscape in many parts of the Island.

8 *Albizzia lebbek* (Leguminoseae,—Mimosoideae). Woman's Tongue, Barbados Ebony.
A medium-sized, more or less deciduous tree, with the lower branches slightly drooping. Leaves—bipinnate, each consisting of two to four rows of leaflets, with three to nine leaflets in each row. The leaflets are one inch to two inches long when mature. The flowers are grouped in heads. They have numerous long stamens of a white or greenish colour, and are sweet-scented. The fruit is a flat, papery pod containing few seeds. These it eventually sheds by dehiscing into halves. For a long time, however, the seeds are loose within the pods and are rattled about

by the wind. The tree produces new leaves and flowers in April and May,—i.e. at the end of the dry season. The fruits become noticeable, but are still green in August. They turn brown in November, and remain in that state until the following April to July, during which time the leaves have almost all dropped off, so that during the months of March to May the most conspicuous feature of the tree is the very large numbers of pale-brown membranous pods,—leaves being almost entirely absent. Sometimes the tree flowers precociously in September. The Woman's Tongue is a native of Bengal, and was probably introduced into Barbados in the 19th century. It is grown in gardens chiefly.

9. *Terminalia catappa* (Combretaceae). Barbados Almond.
A fair-sized tree with more or less regularly-arranged branches, which bear tufts of large leaves of a roundish spoon shape. The leaves are shed often twice or more times during the year. Before falling the leaves turn bright red. The flowers are borne at the ends of the twigs in short racemes; they are small and white. The fruit is an almond-shaped drupe with green pericarp, an extremely hard stone enclosing the seed. The Barbados Almond originated in Africa or Asia. It is a regular member of the sea-shore bushland in many regions in the East, and it is interesting to note that, although probably introduced into Barbados by man, it has established itself in the sandy bushland (Coccoloba) plant association of the Island.

10. *Cordia collococca* (Boraginaceae). Clammy Cherry.
A tree of height up to thirty feet. The branches are more or less horizontal and twisted. The leaves are broad and of length four inches; they are white on their under surfaces. The inflorescence is a many-flowered loose panicle. The flowers are small and white. The fruit is a semi-transparent, pale orange-coloured berry, of diameter ¾ inch. It contains a very sticky pulp, which aids in the dissemination of the seeds by the fact that birds which try to eat it, carry away many of the seeds attached by the mucilage to their beaks. The Clammy Cherry flowers in April and May, and its fruits are ripe in July. It does not shed all its leaves in the dry season, and is therefore not markedly deciduous. The plant is a native of the West Indies, and may be indigenous to Barbados. It is fairly commonly grown in gardens.

11. *Eriodendron anfractuosum* (Bombacaceae). Silk Cotton.
A deciduous tree of well-marked vegetative habit, and of characteristic appearance. In Barbados it seldom grows higher than sixty feet, although in other West Indian Islands (such as Trinidad and Jamaica) it grows as tall as 150 feet. The trunk of the Barbados specimens is four to six feet in diameter, and is furnished with flat plank-like buttress roots, which often reach far up the trunk. It appears that the drier the soil in which the tree grows, the more developed are the buttresses. The branches of the tree come out horizontally from the trunk in a very stiff and formal manner, the lowermost being long, and at a height from the ground of about half the height of the tree. The higher branches are short, so that the crown of the tree is of a squat conical shape. The

thick bark is covered with short prickles. The leaves are deeply divided, consisting of five to seven leaflets each of length about four inches, attached radially to the end of the leaf stalk. The Silk Cotton tree sheds all its leaves at the beginning of the dry season (February). It remains bare until about March, when the large brownish flowers are produced in profusion. The fruits quickly set, and become conspicuous objects. They are large pods,—lemon-shaped and green. Later (in May) the pods turn brown and burst, liberating the seeds. These are enclosed each in a mass of silky wool which permits of the wind carrying away the seeds and so disseminating them. When the pods have burst, the new leaves are put out. These grow out from the buds, which, during the dry season, have been protected by bud-scales. The young leaves are pale-green. They give the tree a very striking appearance at this time, reminding one of the trees of temperate countries in Spring. It is interesting to note that when it happens that a Silk Cotton tree bears few or no fruits, its period of leaf production is much earlier than that of an individual which bears abundant fruits. Also on one tree, those branches which possess few or no fruits produce leaves earlier than those branches which are laden with them. The reason seems to be connected with the question of the relative amount of sap or of stored food material in different individuals, or in different parts of the same individual. The Silk Cotton tree is an indigenous tree. At one time it was undoubtedly very common in the Island, but nowadays it is found only occasionally along roadsides or in gullies.

12. *Haematoxylon campechianum* (Leguminoseae-Caesalpinoideae) Logwood.
A small deciduous tree, with bent trunk and spiny crooked branches. The leaves are pinnate, with 3 to 4 pairs of leaflets in each. The leaves are shed usually in January and the next crop spring out in May. The young leaves are red in colour. In March the flowers are produced. These are small, and grow in great profusion in short racemes all along the branches of the tree. They are yellow in colour and sweet-scented. The fruit is a small, pointed, membranous legume, of length 1½ inches, and contains 1 to 3 seeds. The Logwood is a native of South America, and is now cultivated in many tropical countries where, as in Jamaica, it is grown for the brown or black dye obtained from the wood. It is probably not indigenous to Barbados, and has never been grown in any quantity in the Island.

13. *Crescentia cujete* (Bignoniaceae). Calabash.
A much-branched, small deciduous tree with a flat crown. The leaves are borne in clusters on protuberances of the branches. They are leathery and spatulate in shape, and of length 4 to 8 inches. The old leaves are shed in December, and the fresh leaves grow out in March. The flowers are large and cream-coloured. They are borne singly on the trunk of the tree (cauliflory). The fruit is a large berry with a woody outer layer and pulpy contents, in which numerous flat seeds are embedded. The shape of the fruit varies. It is usually spherical, and of diameter 4 to 12 inches. The shell is used as a utensil. The tree flowers chiefly during the dry season, and the fruits remain attached to the stem for several months. The seeds are probably disseminated by birds or other animals, which pick them up after the fruit has

decomposed. The Calabash is a native of South America and the West Indies, and may be indigenous to Barbados. It is stated by Ligon to have been fairly common there in 1650. It is to be seen growing chiefly near the labourers' huts in all parts of the Island.

14. *Pithecolobium unguis-cati* (Leguminoseae-Mimosoideae) Bread-and-Cheese. This plant is sometimes allowed to grow into a tree, but usually it is cut back so as to form a hedge. The leaves consist each of two oval leaflets of length about one inch. The inflorescence is spherical, and consists of numerous small flowers, with long slender stamens. The fruit is a red, curled, dehiscent legume, which contains several black seeds, each partly enclosed in a fleshy edible aril. This aril probably attracts birds, which devour both aril and seed, and thus bring about the dissemination. The tree produces several crops of flowers during the year;—the number of these crops depending on the distribution of the rainfall. The Bread-and-Cheese tree may be indigenous to Barbados. It is a South American and West Indian plant. It is seen growing in Barbados near labourers' huts and in hedges.

N.B.—Pithecolobium saman.—The Saman Tree of South America, &c., is occasionally grown in Barbados, having recently been introduced into the Island. It is never seen there in its natural massive size, and is grown chiefly in gardens .

15. *Ficus suffocans* (=*?laurifolia*) (Moraceae) Bearded Fig.
(It is supposed by some that the name Barbados was derived from the appearance of this Fig Tree or of some similar species characterised by numerous, fibrous, dangling roots, growing from the branches). The Bearded Fig sometimes grows into a large erect tree with numerous branches bearing dense mats of aerial roots. Many of these reach to the ground and change into woody props, or grow alongside the main stem and become fused into it, giving rise in this way to a deeply ribbed trunk. It is in this form that the Bearded Fig tree is seen in gardens and in regions where the land is flat, but the tree is more often seen in Barbados in what is perhaps its more natural habitat, *i.e.*, in rocky places such as gully walls and inland cliffs (see "Gully-wall and epiphytic shrubs," and "Plants of the undercliff regions"). Here it grows attached to the rock face or perched near the summit of rocky eminences, in which position its epiphytic features are very well shown. The leaves of the Bearded Fig are leathery, elliptical in shape and of length 4 to 6 inches; and breadth 1½ to 3 inches. The fruits are small yellow "figs," not unlike those of the Evergreen tree but larger. The tree is a native of the West Indies, and is probably indigenous to Barbados.

16. *Caryota urens* (Palmaceae).
A palm with columnar stem growing up to a height of 40 to 60 feet. The leaves are twice pinnate, and the inflorescence hangs down like a brush. The fruit is a berry. *Caryota* is a native of the East Indies. It is frequently grown in gardens in Barbados.

17. *Acrocomia sclerocarpa* (Palmae) Macaw Palm.
Indigenous. (See under "Plants of the forest"). The Macaw Palm is occasionally grown in gardens in Barbados.

CHAPTER XIX.

(2) TREES WITH SHOWY FLOWERS, OR OTHERWISE ORNAMENTAL.

The trees tabulated below are arranged in the relative order of commonness. Most of them are plants introduced by man. They are found growing in gardens chiefly. In Queen's Park, Bridgetown, there is perhaps the most varied selection of flowering trees to be found in Barbados.

1. *Poinciana regia* (Leguminoseae,—Caesalpinoideae) Flamboyante.
A deciduous tree, growing up to 50 feet in height. The trunk is usually bent, and the branches tortuous. The main branches are more or less horizontal, so that the tree has a shallow flattish crown. The ends of the branches bend downwards, giving the tree a "weeping" habit. The leaves are put out in late June or July. They are large and bipinnate with very numerous small leaflets. The majority of the leaves are shed during the first few weeks of the dry season, (in February and April), and soon afterwards the flower buds make their appearance. The flowers expand in late May or June, when the tree takes on an aspect of extreme gorgeousness. The inflorescences are racemose, and are borne at the ends of almost every twig of the tree. Each consists of 10 to 20 large flowers of usually a bright-scarlet colour. A certain variety of Flamboyante has orange-red flowers, and another, brick-red flowers. The flowering period extends into September. The fruits quickly make their appearance. They are flattish pods, and grow to a length often of 20 inches, and of width 3 inches. They eventually turn black. The pods remain on the tree for a year or more, and form a conspicuous feature of the tree,—especially during the months when it is devoid of flowers and leaves. Eventually the fruits dehisce into halves, and liberate the numerous hard-coated seeds. The Flamboyante originated in Madagascar, and was introduced into Barbados probably towards the end of the 19th century. It is grown in gardens.

2. *Plumeria alba* (Apocynaceae) White Frangipani, Jasmine Tree.
A small deciduous tree, with very tortuous, succulent, naked, grey branches. The leaves are borne in bunches at the ends of the forked twigs. They appear towards the end of the dry season (in early April). Their shape is oval and their length, when fully grown, about 12 inches. At the commencement of the dry season the foliage of the last year drops off. Quickly, when it has all fallen, the flowers make their appearance, and when these are fully opened the new leaves grow out from the bases of the axes which bear the flowers. The flowers are collected in umbel-like, stalked, terminal branches. The flower is white with a yellow centre, and is heavily scented. The tree bears flowers until September. Occasionally fruits are produced. These are large, broad, woody follicles, of which two are derived from each flower. The Frangipani grows easily in the driest soil. Cut branches lying on the

ground are commonly seen to produce flowers and leaves without the branch having taken root. The tree is very lactiferous, and probably contains abundant stored food material in its stem and branches. The Frangipani is a native of Mexico, and was brought to Barbados probably early in the 18th century.

Plumeria rubra (Apocynaceae) Red Frangipani.
This species bears red flowers, but is otherwise very like the above, except that it flowers perhaps rather earlier. Both species are found in most gardens in Barbados.

3. *Cordia sebestena* (Boraginaceae) Scarlet Cordia.
A medium-sized evergreen tree which bears broad fairly large leaves. The leaves are stiff and rough, and exhibit xerophytic features. The flowers are borne in conspicuous branches, the tree seldom being devoid of them. The fruit is a white drupe of which the fleshy layer has been derived from the calyx of the flower, a fact of some botanical interest. The Cordia is perhaps an indigenous plant. It is commonly grown in gardens in Barbados, but it is also found growing and reproducing itself freely in the sandy-bushland (Coccoloba) plant association of the sea shore.

4. *Citharexylum quadrangulare* (Verbenaceae) Fiddle Wood.
A medium-sized deciduous tree. Its leaves are numerous, and of a rich green colour when young. Before falling off at the beginning of the dry season, they turn salmon-pink or yellow. The new leaves are produced very soon after all the old leaves have fallen, provided that the soil is fairly moist. The oncoming of the wet season (May or June) causes the tree quickly to put out its new foliage. The flowers of the Fiddle Wood are small, white, and sweet-smelling. They are borne in pendulous racemes from the ends of the twigs. The tree produces three or more crops of flowers each year during the wet season, the first crop being put out almost as soon as the first leaves make their apparance.
The common name Fiddle Wood is probably a corruption of the French name of the tree—Bois fidele. The plant is probably indigenous to Barbados. It is a member of the forest association.

5. *Moringa oleifera* (=*pterygosperma*) Moringaceae) Horse-radish Tree.
A small slender tree, with leaves three times divided. The white flowers are borne in terminal racemes. The fruit is a long three-sided capsule, of length usually 1 foot and width 1 inch. It contains numerous closely-packed seeds, each of which possesses three membranous wings. A native of tropical Asia and India. The East Indians eat the cooked leaves and young fruits. The root is said to be a good substitute for horse radish. *Moringa* was introduced into Barbados early in the 19th century.

6. *Morinda citrifolia* (Rubiaceae) Wild Pine.
A small evergreen tree, with very large, shiny, oval, bright green leaves. The lower branches of the tree have a drooping habit. The flowers are collected on globose fleshy receptacles. They are small, white, waxy and sweet-scented. The ripe fruit is a large, yellowish, multiple fruit, consisting of the fused ovaries of the flowers and containing many black

seeds. The fruit resembles somewhat a small pine-apple. It falls to the ground, and decays there into a putrid mass. The tree flowers almost all the year round. The Wild Pine is an East Indian plant, and has perhaps not long been grown in Barbados.

7. *Guaiacum officinale* (Zygophyllaceae) Lignum Vitae.
A medium-sized evergreen tree, with wide spreading stout branches. The bark is thick, and is covered with a greenish crust, which peels off in flakes. The leaves are pinnate, and consist of two or three oval leaflets, each of length ½ to 1 inch. The flowers are very numerous, and are collected in terminal groups of 2 to 10 flowers. Each flower is flat, bright-blue in colour and 1 inch across. The fruit is a compressed yellow berry of length ¾ inch. It is shaped like an inverted heart. It contains two or three chambers, each with an oval seed surrounded by a thin red pulpy layer. Often all the seeds except one are aborted. The wood of the Lignum Vitae is very dense and hard, and exudes a gum which has medicinal uses. The tree grows very slowly, and flowers habitually twice a year. It is a North and Tropical American tree, and may be indigenous to Barbados. Ligon mentions it in his account of the flora of Barbados. It is found growing chiefly near residences in the country districts of the Island.

8. *Capparis cynophallophora* (Capparidaceae) Black Willow.
A small evergreen tree. Leaves; numerous, elliptical, with shining, dark-green upper surfaces, and scaly brownish-grey under surfaces. Length of leaf 3 to 4 inches. The flowers are grouped in short terminal cymes. They are white, and of diameter ¾ inch. They possess numerous long stamens. The ovary is stalked. The fruit is a pendulous, cylindrical, fleshy siliqua, of length up to 10 inches, and breadth ½ inch. It ruptures irregularly along one side, and flattens out, exposing a bright-red inner surface, to which are attached by slender threads, two rows of round soft-skinned seeds. In the seedling the leaves are linear and of length 5 to 8 inches and breadth ½ inch. The Black Willow flowers almost all the year round especially in May to September. If properly trimmed it grows into a dense symmetrical tree of imposing appearance.

9. *Capparis indica* (Capparidaceae) White Willow.
Very similar to the last, but the leaves are not so dark coloured above nor so grey below. The Willows are natives of South and Central America.

10. *Lonchocarpus violaceus* (Leguminoseae,—Papilionatae). Spanish Ash.
Indigenous. (See under "Plants of the forest"). The tree is commonly grown in gardens.

11. *Cassia fistula.* (Leguminoseae,—Caesalpinoideae) Purging Cassia.
A small tree with imparipinnate leaves, each with 5 to 9 pairs of large, pointed leaflets. The leaves are put out in June. During June and July the tree is covered with long pendulous racemes of fairly large bright-yellow flowers. The fruit is a long, cylindrical, indehiscent, black legume, of length often 20 inches, and breadth ¾ inch. It is divided into many chambers, in each of which is embedded a seed in

dark sticky pulp. The fruits remain on the tree for the greater part of the year. *Cassia fistula* is a common tree in the forests of India and Ceylon. It was perhaps introduced into Barbados in the early days of its settlement although there is some evidence that its seeds may have reached the West Indies through the agency of the South Equatorial Current. It is grown in gardens.

12. *Cassia grandis* (Leguminoseae,—Caesalpinoideae) Pink Cassia or Horse Cassia.

A small tree which possesses compound leaves each with 10 to 20 pairs of leaflets. The flowers are arranged in long racemes, and are of a pink colour. Legumes;—short (4 inches) and thick (2 inches diameter). The flowering and leafing periods are earlier than in *C. fistula. C. grandis* is a native of South America, and is also indigenous in the larger West Indies Islands.

13. *Cassia marginata* (=*javanica*) (Leguminoseae—Caesalpinoideae) Pink Cassia.

A small graceful spreading tree with a weeping habit. Compound leaves with 10 to 20 pairs of blunt oval leaflets. The flowers are rose pink, and are arranged in numerous racemes. The legumes are pendulous. The tree flowers in May. Place of origin East Indies.

A few other species of *Cassia* are occasionally grown in gardens in Barbados, but the above are the most common.

14. *Bauhinia kappleri* (Leguminoseae,—Caesalpinoideae) Napoleon's Cocked Hat.

A small slender deciduous tree, with large alternate, thin, bilobed leaves, 4 inches long. Flowers;—large, pink, arranged in few-flowered cymes. The legumes are dehiscent, and about 6 inches long. The tree sheds its leaves in February and puts out its flowers in May and June. It is a native of the East Indies.

15. *Bauhinia tomentosa* (Leguminoseae,—Caesalpinoideae) Bauhinia.

A shrubby tree very similar to the above, but the flowers are pale-yellow in colour, turning rosy when old.

16. *Melia azedarach* (Meliaceae). Barbados Lilac, Bead Tree.

A small deciduous tree, with slender drooping branches. Leaves;—imparipinnate, with 3 to 11 oval dentate leaflets of length 2 inches. Flowers arranged in large erect, terminal, cymose panicles. Each flower has 5 pale-violet petals of length ⅓ inch, and numerous dark-red stamens united to form a tube. The fruit is an almost spherical drupe, ¾ inch diameter, and of a yellow colour. The infructescences are pendulous. The lilac is a native of Persia and Syria.

17. *Nerium oleander* (Apocynaceae) Oleander.

A shrubby tree, not unlike the Frangipani in general appearance, except that its leaves are much narrower and the flowers smaller. The Oleander is a native of the Mediterranean region.

18. *Gliricidia maculata* (Leguminoseae,—Papilionatae) Madre.
A quick-growing deciduous tree, with long arching branches. In February the otherwise bare tree is covered with short racemes of pale-violet flowers, which are soon replaced by short green pods. The pods attain a length of 4 to 6 inches and then turn brown. By this time the tree is clothed with pinnate leaves, which remain on the tree from May to December. *Gliricidia* is much used in the Northern Antillean Islands as a wind break for cotton plants. It is a native of South America, and was but recently introduced into Barbados.

RARE LEGUMINOUS TREES WITH SHOWY FLOWERS.

1. *Agati grandiflora* (Papilionatae).
A small deciduous tree, with horizontal branches and slender stems. Leaves;—pinnate, of 14 to 20 pairs of leaflets. Flowers borne in small axillary groups. Each flower is very large (3 inches long). and of a cream or pink colour. The fruits are long thin legumes. *Agati* was introduced from the East Indies. It puts out its flowers in March to June.

2. *Andira inermis* (=*jamaicensis*). (Papilionatae). Wild Olive.
(Angelica of forests of South America, Jamaica, &c.) Bears numerous racemes of purplish flowers. The fruit is a small one-seeded drupe. *Andira* is a West African plant. Its seeds are often found cast up on beaches of West Indies Islands.

3. *Piscidia erythrina* (Papilionatae).
A small, much-branched, deciduous tree, with pale-green, compound leaves, each of 3 to 5 leaflets. The flowers are pale-red, and are grouped in large panicles. Legumes;—small, indehiscent. The tree is of West Indian origin.

4. *Erythrina corallodendron* (Papilionatae) Coral-bean Tree or "Shrove Tuesday."
("Bois immortel" of forests of South America, Trinidad, &c.). A medium sized tree, which bears very numerous red flowers in March and April.

5. *Peltophorum ferrugineum* (Caesalpinoideae).
A tall tree native of Ceylon and Malay. A good specimen is to be seen growing in Queen's Park. It bears numerous erect panicles of bright-yellow flowers, which are produced in March. The young shoots are covered with brown velvety hairs, giving them a rusty appearance.

NOTE ON THE PERIODICITY OF THE SHADE TREES, AND OF THE SHOWY FLOWERING TREES OF BARBADOS.

From records of observations of the main features of the vegetative activity of common trees belonging to the above groups as represented in Barbados, the following general conclusions may be drawn:—

1. DECIDUOUS TREES.

In the case of *deciduous* trees, (i.e. those trees which shed their leaves more or less completely once a year, such as Mahogany; Sand Box; Woman's Tongue; Silk Cotton; Flamboyante; Frangipani; Fiddle Wood; Cassias; and certain other Leguminous trees),—the period of leaf fall roughly coincides with the latter part of the dry season.

Leaf fall is known to botanists to be a definite physiological process resulting from a diminution in the supply of water to the leafy twigs. Whether the reduction in water supply is due to the drying of the soil, (as is the case with tropical deciduous trees), or to the inability of the root-system to absorb water because of a lowering of soil temperature (as is the case with deciduous trees of temperate countries during winter), is of no account. It has been demonstrated that the reason why leaves drop when water shortage occurs is that a layer of tissue (cork) is formed, usually across the base of each leaf. Thus, even before the detachment of the leaf takes place, the wound is healed in advance. Although water shortage is the chief cause of leaf fall, other processes that go on in a plant, especially those connected with nutrition, are concerned in the bringing about of the formation of this separation layer or abciss layer.

Several factors are therefore responsible in deciding the date in the actual shedding of the leaves of a tropical deciduous tree. The chief are:—

(A) EXTERNAL.

(1) The *earliness or lateness* of the commencement of the dry season, and the occurrence or non-occurrence in it of breaks, when showers of rain replenish the supply of water in the soil.

(2) The *position, drainage, depth, composition, &c* of the soil in which the particular individual tree is growing, these factors being concerned with the actual amount of water available to the tree roots.

(B) INTERNAL.

(3) The *kind of tree* (whether Mahogany, or Silk Cotton or Flamboyante, &c.),—each species having its own peculiarities in connection with such process as (i) absorption at the roots, (which depends chiefly on the extent of the root system); (ii) rate of transpiration, (which partly depends on structure of the leaf;—whether its surface is protected so as to minimise evaporation, or whether the number of pores (stomata) in it is small or large, &c); (iii) production of flowers and fruits, which exercises a great drain on the sap content, so that a specimen of, say, a Silk Cotton tree which happens to produce few flowers or fruits, is frequently seen to drop its leaves later, and to produce its new leaves earlier than one which produces a large crop of flowers and fruits; (iv) nutrition, (which depends on the properties of the leaf, and the rate at which chemical changes go on in the body of the tree).

(4) *The age of the tree,* (young trees often not shedding their foliage at all; others only in part).

By a consideration of the above factors, the differences between the periods of leaf fall, leaf production, &c., of trees of different species, or of individuals of the same species, may partly be elucidated. It must be borne in mind that the final result in any particular case is to be explained by the combined effect of the numerous and intricate factors that are at work.

2. EVERGREEN TREES.

In the case of *evergreen* trees, (i.e. those trees which shed few of their leaves in the dry season, so that the trees are never devoid of foliage, *e.g.* Evergreen; Tamarind; Casuarina; Palms; Cordia; Lignum Vitae; and the Willow), the same factors as laid out above are also effective.

In the preceding notes describing the features of each of these trees, it will be found that, for the most part, they have the following points in common:—

(i) Evergreen trees have very extensive root systems, so that they are able to draw on large volumes of soil for moisture.

(ii) The structure of their leaves is such that loss of water by transpiration is much reduced, i.e. the leaves have xerophytic characters. (e.g. the leaves of the Evergreen are small, leathery, covered with thick cuticle, contain a milky juice, &c., and those of the Casuarina are almost altogether absent:—the slender green stems of this tree taking on the role of leaves).

True evergreen trees have no definite time of leaf fall, although they drop most of their leaves in the dry months of the year, and put out most of their new leaves during the wet months.

The two groups Deciduous trees and Evergreen trees are not sharply defined, for several kinds of trees, (e.g. Sand Box and Whitewood) cannot strictly be placed in either class, since they frequently retain many of their leaves all through the dry season.

Special note may be made of trees such as Fiddle Wood and Barbados Almond, which habitually shed most of their leaves more than once in a year. It is hard to understand why this is so, probably the internal processes are here the chief factors that operate.

In conclusion it is interesting to note that the common deciduous Barbados shade trees and trees with showy flowers may also be arranged fairly definitely into two groups in accordance with the habit of some in producing their flowers at the same time as they produce their new leaves, and of others in producing flowers and leaves at different times.

Examples of trees which produce flowers and new leaves together are—Mahogany; Woman's Tongue; Bread-and Cheese; Frangipani; Fiddle Wood; and Barbados Almond.

Examples of trees which produce flowers and leaves at different times are —Silk Cotton; Flamboyante; and species of Cassia. The habit of a tree in connection with its flowering (and subsequent fruiting) period may have some influence on the time of its leaf-fall.

CHAPTER XX.

(3) THE FRUIT TREES OF BARBADOS.

Fruit trees are not cultivated in Barbados to an extent sufficient to allow of an appreciable export trade, nor even sufficient always to supply local needs. Of those fruit trees that grow in the Island two classes may be recognized.

(A) Fruit trees which grow without special attention in gardens and orchards near dwelling houses in all parts of Barbados.

(B) Fruit trees which grow well only in special situations shielded from wind, and provided with a plentiful supply of water. Such conditions prevail in certain gullies in the more rainy (upland) districts of Barbados.

A. FRUIT TREES OF GENERAL DISTRIBUTION.

(arranged in approximate order of commonness)

1. *Mangifera indica* (Anacardiaceae) Mango.
A fairly large evergreen tree, with thick bark. The leaves are long, leathery, oval-shaped, and are grouped together in tufts at the ends of the twigs. The flowers are tiny and are arranged in large erect terminal panicles. The fruit is a yellow drupe, of size depending on the variety of the mango. It may be as short as two inches or as long as six inches by two-thirds as broad. The "stone" is flat and woody. In certain kinds of mango the flesh of the fruit is fibrous, and the flavour reminds one of turpentine. Certain grafted mangoes (such as the "Julie" mango) have non-fibrous flesh, and a flavour surpassing that of all other tropical fruits. The Mango flowers in Barbados in January and February, and the fruits are ripe in May to July. It is a native of the East Indies or of Tropical Asia, and was probably introduced into Barbados towards the end of the eighteenth century.

2. *Spondias lutea* (Anacardiaceae) Hog Plum.
A fair-sized deciduous tree, with many branches, and thick bark. The leaves are clustered together at the extremities of the twigs. They are impari-pinnate;—each consisting of 5 to 7 pairs of leaflets of average length 2½ inches. The small flowers are arranged in loose panicles. The fruit is a golden yellow drupe about 1½ to 2 inches long and ¾ to 1 inch broad. It has on it several (2 to 5) small protuberances left by the styles as they dropped off from the flower. The flower is astringent, and usually not very agreeable. The tree sheds its leaves in January and bears flowers in April. Soon after the flowers are out, the new crop of leaves is produced. The fruits ripen in August to December.

3. *Spondias purpurea var.* (Anacardiaceae) Chili Plum.
A fair-sized deciduous tree, with bunched impari-pinnate leaves 6 inches

long, and composed of 9 or 11 pairs of leaflets. The small red flowers are arranged in racemes along the branches. The fruit is a smooth, large-stoned, yellow drupe, oval in shape, and of length 1½ inches. The flowering, leafing and fruiting periods are the same as those of the "Hog Plum."

4. *Spondias purpurea.* (Anacardiaceae) Jamaica Plum.
This is botanically identical with the Chili Plum, but the fruit is purple instead of yellow. All the above mentioned plum trees are West Indian. The first may even be indigenous to Barbados. They were primarily possibly brought from Africa by ocean currents.

5. *Spondias dulcis* (Anacardiaceae) Golden Apple.
This is a small deciduous tree similar in habit to the plum trees. The fruit is a yellow drupe, 3 inches long possessing a large fibre-covered stone. The fruits ripen in November to January. The Golden Apple is a native of the Society Islands, and was introduced into Barbados in the early part of the 18th century.

6. *Citrus medica var: acida* (Rutaceae) Lime.
A small, shrubby, evergreen tree, with leathery, elliptical, fragrant leaves, and spiny branches. The waxy flowers and fruits are borne singly. The plant bears flowers and fruits (berries) almost all the year round especially in the wet season. It is grown in most gardens in all parts of the Island,—the sour fruit being chiefly employed for culinary purposes. The Lime originated in the East, and was introduced into Barbados soon after the date of settlement.

7. *Zizyphus jujuba* (Rhamnaceae) Dunk.
A small tree with tortuous branches, which bend downwards at their extremities. The leaves are small, elliptical, finely dentate, and covered below with downy hairs. In the axil of each leaf are two curved spines. The flowers are arranged in small, axillary cymes along the branches. They emit an offensive odour. The fruit is a small, 2-seeded drupe, resembling very much in appearance and flavour an over-ripe English Crab-apple. It is generally only eaten by children. The Dunk tree grows in gardens and waste places in most parts of the Island, and flowers generally twice during the wet season. The leaves are never entirely shed, but are most plentiful at the end of the wet season. The fruits are ripe usually in July and again in February. The Dunk is a native of East India and Malay. It was probably introduced into Barbados in the early 18th century, and has spread itself so as to become a common plant of certain associations.

8. *Malpighia glabra.* (Malpighiaceae) Barbados Cherry.
A much-branched, low evergreen tree with small leaves. Flowers;—numerous, usually in umbels of 3 to 6 flowers each, and pink in colour. Fruit:—a drupe almost spherical, diameter ¾ inch, bright red in colour with 3 to 4 separate, triangular stones, each with one seed. The tree produces several (as many as five) crops of fruit each year, most of them during the rainy season. The tree is South American and West

Indian in origin. It was noted by Ligon in 1657, and may, therefore, be indigenous to Barbados.

9. *Anona squamosa.* (Anonaceae) Sugar Apple.
A small, more or less deciduous tree, with simple entire leaves. These are put out chiefly at the beginning of the wet season (May). The flowers appear in April or May. Each flower has 3 small, (¾ inch) green, fleshy petals and a small, conical, apocarpous ovary. The fruit is a globular, tuberculate, compound fruit of diameter about 2½ inches. It easily breaks up into segments when ripe, each segment containing one hard black shiny seed. The fruits ripen in September to January.

10. *Anona muricata.* (Anonaceae) Sour Sop.
Similar to the above, but less deciduous, or almost quite evergreen. The flowers possess large, green, convex petals. The compound fruit is large (7 inches long), ovoid and spiny. It has an acidic taste, and is used chiefly for flavouring ices. The fruiting period extends from September to January.

11. *Anona reticulata.* (Anonaceae) Custard Apple.
A small shrubby tree, not so common as the two last named. The compound fruit is globular, smooth, and 4 inches in diameter. Most of its leaves are produced in May, along with flowers. The fruits ripen in August to December. *Anona* is a native of South America and the West Indies. Its species may be indigenous to Barbados, since they are mentioned by Ligon (1657).

12. *Psidium guajava.* (Myrtaceae) Guava.
A shrub of height up to 10 feet. It grows wild in many parts of Barbados, and is especially common along waysides in the northern part of the Island. It may be an indigenous plant. The flowers are fragrant, white, and of diameter 1 inch. They possess numerous stamens and inferior ovaries. The fruit is a spherical berry, diameter 1½ inches, with numerous seeds embedded in a pinkish pulp. It is used chiefly for making guava jelly or preserves. The plant bears fruits most of the year, especially in the wet season.

13. *Persea americana* (=*gratissima*) Avocado Pear. (Lauraceae).
A fairly large evergreen tree, with elliptical leaves, and small flowers grouped in panicles. The flowers are produced in March. The fruit is a large pear-shaped berry, containing one very large seed. The fleshy layer is oily, and of thickness ¾ inch. It is used in salads. The skin is tough and green, or dark purple. The fruits ripen in July to December. The Avocado Pear is a native of South America, and was introduced into Barbados by man at some fairly remote date.

14. *Punica granatum=cicca* (Punicaceae) Pomegranate.
(See under "garden plants.")
Commonly grown in gardens. It is mentioned by Ligon (1657) as being native to Barbados.

15. *Phyllanthus distichus* (Euphorbiaceae) Barbados or Otaheite Gooseberry.
A low-spreading evergreen tree with numerous small leaves grouped in two rows (distichous) on the twigs. The male and female flowers are arranged in clusters all along the branches of the tree. The fruit is a globose, ribbed, green drupe, containing several (usually 4) seeds. It has an acid flavour, and is chiefly used in making preserves. The tree flowers and fruits twice a year in the wet season. It is a native of India and Malaya.

16. *Melicocca bijuga* (Sapindaceae) Genip or Ginep.
(Often wrongly called Akee in Barbados). A fairly tall evergreen tree, with pinnate leaves of two pairs of leaflets each. Flowers;—odorous, arranged in terminal panicles. Dioecious. Frequently a tree produces almost all male flowers. Fruits;—in clusters. Each, a spherical berry, 1 inch in diameter, green, with sticky pulp, enclosing two or three seeds. South American.

17. *Carica papaya* (Caricaceae) Papaw.
A herbaceous tree up to 15 feet high. Dioecious. The leaves are borne in a crown at the summit of the succulent stem. The leaf is large and palmate. The fruits of the female trees are borne in the axils of the leaves. They are orange-yellow in colour, large, (often 1 foot long), and round or oval in shape. The fruit is a berry, and contains numerous, parietally-placed seeds. The juice of the fruit yields papaine. The Papaw bears flowers and fruits all the year round. Place of origin,—South America and West Indies. It was grown in Barbados at the time of Ligon's visit (1657) and may be an indigenous plant.

18. *Mammea americana* (Guttiferae) Mammee Apple.
A medium-sized evergreen tree, with fairly large, oval, shiny, leathery leaves. The flowers are borne in the leaf axils, and are small, white and odorous. The fruit is a spherical drupe, 3—5 inches in diameter, with thick russet skin, and contains one or more seeds enclosed in a fibrous endocarp. The tree generally flowers twice a year, most prolifically in November, giving fruits in April. South American, and probably indigenous to Barbados.

19. *Citrus decumana* (Rutaceae) Shaddock.
A small tree with leathery leaves. The fruits are very large, and have a thick rind. Often they reach a diameter of 1 foot or over. When fully grown, they pull the branches of the trees down to the ground. The Shaddock is grown in a few gardens in Barbados, and is more widely distributed than the less hardy citrus trees (Grape fruit and Orange), to be described later. The tree was brought to Europe from China by Captain Shaddock, a Scotsman, and from Europe it reached the West Indies early in the 18th century.

(B) FRUIT TREES GROWN IN SHADY, MOIST AND PROTECTED LOCALITIES.

1. *Citrus decumana var: racemosa* (Rutaceae) Grapefruit.
A small evergreen tree, with thick, leathery, fragrant leaves. The clusters of small, waxy flowers are produced in January to March, and the fruits (berries) are ripe in June to July. A second crop of flowers generally comes out in August, giving fruits in December. The Grapefruit originated in China.

2. *Citrus aurantium* (Rutaceae) Orange.
Similar to the above, but the fruits are not so large and are sweeter. Flowering and fruiting periods as above. Originated in China.

3. *Citrus nobilis* (Rutaceae) Tangerine Orange.
Similar to the above, but the fruits are smaller and thin-skinned. Grown only occasionally in Barbados. Citrus fruits are cultivated in orchards and gardens in the northern hilly and rainy districts of the Island, but not so extensively nowadays as formerly. They were introduced soon after the date of settlement (in 1625).

4. *Achras sapota* (Sapotaceae) Sapodilla.
A fair-sized evergreen tree with many branches, the lower horizontal. The twigs are covered with a rust-coloured down. The leathery leaves occur in bunches at the ends of the twigs. They are 3 inches long, and narrow. The flowers are solitary in the leaf-axils. The fruit is a berry, in appearance somewhat like a roundish English potato. It contains several black shining seeds, embedded in a dark-brown, juicy pulp. The tree bears fruits most of the year, but especially in April to July. The Sapodilla is a native of South America and the West Indies, and is probably indigenous to Barbados. It is not common in the Island.

5. *Psidium cattleyanum* (Myrtaceae) Spice Guava.
A shrubby tree, similar to the above. The fruits may be eaten as dessert. They are ripe generally in May to September. The tree guavas are of South American origin, and were probably cultivated in certain Barbados orchards from the earliest times.

6. *Psidium pyriferum.* (Myrtaceae) French Guava.
A small tree,—otherwise similar to the common Guava. The fruit is larger and has a better flavour than the common Guava.

7. *Chrysophyllum cainito* (Sapotaceae) Star Apple.
A medium-sized evergreen tree, with fairly large oval leaves of a dark-green colour above and a rich brown beneath. The flowers are borne in small clusters in the axils of the leaves all along the branches. The fruit is a spherical berry of diameter 3 inches. It is of a purple colour, and contains usually 4 perfected seeds (although as many as 10 might start developing from the ovules). The Star-Apple bears fruits chiefly in April to July. It is not common in Barbados. It is a native of the West Indies.

8. *Anacardium occidentale* (Anacardiaceae) Cashew.
A medium-sized, spreading, evergreen, tree, with fairly large, oval, leathery leaves, which are reddish in colour when young. The small flowers are collected in large terminal panicles. The fruit consists of 2 parts, (a) the fleshy receptacle, red in colour when ripe, pear shaped, 2—4 inches long. It has an acid flavour; (b) the nut, of a dark colour, kidney shaped, 1 inch long, with woody pericarp. The Cashew flowers in December to April and the fruits ripen in April to June. The tree is a native of South America and was probably introduced by man into Barbados early in the 18th century. It grows nowadays only in a few localities, chiefly in the Scotland District, on poor, dry, sandy soil.

9. *Blighia sapida* (Sapindaceae) Akee.
The true Akee as contrasted with the Genip which latter is often called Akee in Barbados, is a small tree with pinnate leaves, each of three or four pairs of leaflets 3 inches long. The flowers are small, white, fragrant and hairy. They are arranged in groups in the leaf-axils. The fruit is a three-sided, dehiscent, reddish berry 4 inches long, containing 1 or 2 black, shiny seeds. The seeds are partly enclosed in a white aril. The aril is said to be poisonous, but if properly cooked it is edible. The Akee is a native of tropical Africa and although common in the West Indies, especially Jamaica, it is rare in Barbados. There is one specimen of the tree in Queen's Park.

NOTE ON THE PERIODICITY OF THE FRUIT TREES OF BARBADOS.

From the above notes, the following general conclusions as to the periods of vegetative activity of the fruit trees of Barbados may be drawn:—

(a) In the case of the *deciduous* fruit trees, (i.e. those that completely shed their leaves once a year) the leaves begin to fall at the commencement of the dry season, so that during the months of December to April, the trees are bare. At the beginning of the rainy season, (i.e., in May or early June), the deciduous fruit trees put out their flowers. Soon after this, the new leaves make their appearance, and by the middle of the rainy season, these are fully expanded. The fruits, at the same time are ripening. Thus the fruits of the deciduous fruit trees of Barbados come into season between the months of August and December.

e.g. Plums, Golden Apple, Sugar Apple, Sour Sop, Custard Apple.

(b) In the case of the *evergreen* fruit trees, the leaves are never altogether absent from the trees, but most of the old leaves are shed in the dry season, and most of the new ones are produced in the wet season. The flowers of the evergreen fruit trees are usually put out during the dry season, and the fruits ripen in the early part of the next rainy season; i.e., the fruits of the evergreen fruit trees come into season chiefly during the months of June and November.

e.g. Mango, Avocado Pear, Citrus, Mammee Apple, Cashew.

The distribution and intensity of the rainfall during the wet months of the year, however, greatly influence the time of flowering and fruiting of the evergreen fruit trees. In many instances, these irregularities cause the production of more than one crop of flowers and fruits in the rainy months, or of none at all.

e.g. Cherry, Dunk, Gooseberry, Guava, Genip, Sapodilla, Star-Apple.

CHAPTER XXI.

(4) THE GARDEN PLANTS OF BARBADOS (SHRUBS AND HERBS)

These are almost all introduced plants. In the lists given below it is to be understood that (unless otherwise stated), each plant has been introduced into Barbados through the agency of man.

In order to enable the student to appreciate the botanical relationships of the different species, the garden plants of Barbados have been arranged in their Families or Natural orders. The use of a dictionary of plants (such as that compiled by Willis; see Bibliography, No. 3) is all that is required for the acquirement of more detailed knowledge of the plants in the list. The value of a compilation of names of the chief garden plants of Barbados, therefore, chiefly lies in its serving as a guide to literature on the subject, and in its indicating the range of plants which are grown with success under local conditions. Some attempt has been made to trace the origin of the Barbados garden plants, and, in as many cases as possible, to supply the vernacular or common name of each. Difficulty has been experienced with the assignation of the common names, since, in Barbados, most garden (as well as wild) plants are known each by several names. As far as possible, the best-known of the synonyms are given in the lists.

(A) MONOCOTYLEDONS.

PANDANACEAE.

Pandanus utilis. Screw-Pine.
Possesses prop roots. Place of origin South Sea Islands.

GRAMINEAE.

Bambusa spp. Bamboo.
Very rare in Barbados. Probably introduced.

Coix lacryma. Job's Tears.
Possesses pear-shaped, hard swellings at the base of each inflorescence. A native of India.

Arundo donax. Variegated Reed.
A bushy grass up to 6 feet high. Leaves pale. Inflorescence a large panicle. Mediterranean.

PALMAE.

Livistonia sp. Livistonia Palm.
Possesses fan-leaves. India.

Thrinax spp. Thatch or Fan Palm.
West Indian. (*Thrinax barbadense* is said to be indigenous to Barbados, but is rarely, if ever, seen growing wild nowadays).

ARACEAE.

Anthurium sp. Anthurium of conservatories.
Possesses broad, red spathes. Probably of South American or West Indian (Trinidadian) origin.

Caladium sp. (e.g. *bicolor*). Variegated Caladium.
Possesses large peltate pink-and-green leaves. South American origin.

COMMELINACEAE.

Tradescantia (=*Rheo*) *discolor.* Moses-in-the-bulrushes. West Indian.

Zebrina pendula. Wandering Jew.
Very much like the common Pond Grass, but has larger blue flowers and purple leaves. West Indian.

LILIACEAE.

Dracaena spp. Dragon Tree.
Erect plants up to 12 feet high. The stem has few branches. Leaves terminal, 2 feet long, green or red in the different species.

Sanseveria guineensis. Hemp.
Common in rock borders. Possesses stout, fibrous, dark-green leaves, with mottled, whitish V-shaped bands across them. Bears flowers in March. African or Indian.

Gloriosa superba. Gloriosa.
Possesses leaf-tendrils. A climber. African.

AMARYLLIDACEAE.

Eucharis grandiflora. Eucharis Lily.
Grows wild on the banks of the Amazon.

Hippeastrum puniceum (=*equestre*). Easter Lily or Barbados Red Lily.
Indigenous. Grows wild in gullies. Origin, West Indies and Tropical America.

Crinum amabile—Lily.
Flowers arranged in an umbel, drooping, bell-shaped, white, with pinkish stripes. East Indies.

Hymenocallis caribbea (=*Pancratium caribbaeum.*) Spider Lily.
Flowers twice a year. The flower possesses six long, narrow, perigonal lobes (petals). Stamens;—long and inserted on a crown. West Indian.

Zephyranthes (=*Amaryllis*) *tubispatha*—Barbados Snowdrop.
A small plant, (up to 1 foot high), grown in borders. Flowers white, and not unlike the English Crocus in shape. West Indian and perhaps indigenous.

Zephyranthes carinata. Snowdrop.
Similar to the above, but the flowers are larger and pink in colour. West India.

CANNACEAE.

Canna spp. & vars. Canna.
Flowers: red, yellow, or red, variegated with yellow. Flowering period August to December. Indian.

ORCHIDACEAE.

e.g. Oncidium papilio &c., *Catasetum spp., Cattleya spp., Dendrobium spp., Epidendrum spp.* Orchids.
Many genera, species and varieties are cultivated in conservatories with some success. Many of these are imported from South America, (Guiana. &c.)

(B) DICOTYLEDONS.

POLYGONACEAE.

Antigonon leptopus. Coralita.
A favourite climber. Has stem-tendrils, and bears pendulous racemes of pink flowers, which are borne in December and January. A variety with white flowers is also cultivated.

Antigonon sp.. (*?cinerascens*).
This bears pink flowers which are larger and more open than those of the common Coralita. Place of origin of *Antigonon*: Mexico.

AMARANTACEAE.

Gomphrena globosa. Bachelor's button.
An annual. Flowers: small, with crimson bracts, and arranged in a head. There is also a white variety. Place of origin, East Indies.

Amarantus gracilis (=*caudatus*) Love-lies-bleeding. Red Caterpillar, &c.
Flowers with crimson bracts, arranged in long cylindrical spikes. Cosmopolitan.

Celosia cristata. Crimson Cockscomb.
A monstrosity, in which the branches of the inflorescence are united laterally, giving a peculiar crested effect.

NYCTAGINACEAE.

Bougainvillea glabra. Bougainvillea.
A favourite creeping and climbing shrub, whose large showy, purple floral bracts are often mistaken for petals. The bracts of the species *B. glabra* soon turn brown.

B. glabra var. sandariana. Bougainvillea.
This has larger and richer-coloured (magenta) bracts, which do not wither so quickly as the last.

B. spectabilis var. laterita. Bougainvillea.
This has brick red (terra cotta) bracts.

Bougainvillea (species or var: unknown)
This is a new species or variety with crimson bracts. It is known locally as "Mrs. Butt." Place of origin of *Bougainvillea*: South America and Mexico.

CARYOPHYLLACEAE.

Dianthus spp. & *vars.* Carnations and Pinks.
Many common European species and varieties are cultivated in Barbados, but with little success.

CRUCIFERAE.

Iberis amara & *vars.* Candytuft.
European.

Alyssum sp. Sweet Alyssum.
European.

ROSACEAE.

Rosa spp. & *vars.* Double Rose.
The common English and American florists' varieties are cultivated, often with great success in Barbados. They grow best on their own roots, budded plants not being so satisfactory. Many of the varieties seem to degenerate under cultivation.

LEGUMINOSEAE.

Caesalpinia pulcherrima. Barbados Pride. Flower Fence.
The only shrubby leguminious plant cultivated in gardens of Barbados. There is a red-and-yellow flowered variety and a pure yellow-flowered variety. A very common plant in hedges. Widespread in the Tropics.

GERANIACEAE.

Geranium spp. & *vars.* *Pelargonium spp.* & *vars.*
The Scarlet Geranium is the most commonly grown but it does not flourish in Barbados. Introduced from Europe.

TROPEOLACEAE.

Tropeolum spp. Nasturtium.
Place of origin, South America, but probably introduced from England. Do not grow well in Barbados.

MALPIGHIACEAE.

Galphimia (=*Thryallis*) *glauca.* Canary Plant.
A common shrub, with numerous yellow flowers. Mexican.

EUPHORBIACEAE.

Codiaeum variegatum, &c. Croton of Gardens.
Very commonly-grown shrubs, with showy variegated leaves. Australian, &c.

Poinsettia pulcherrima. Poinsettia.
A lactiferous shrub, with lanceolate floral bracts of a bright-scarlet colour. Grows wild on the mountain slopes of Mexico.

Acalypha spp. Acalypha.
Shrubs with variegated leaves. Indian, &c

Pedilanthus spp.
Variegated specimens of this succulent lactiferous herb are occasionally grown in gardens. The general shape of the plant is similar to that of *P. tithymaloides* of the Rock association of Barbados.

Euphorbia spp.
Variegated. Several cactus-like Euphorbias are found occasionally in gardens. A common one is a candelabrum-like xerophyte with squarish, angular, green stems devoid of leaves.

Jatropha curcus. Physic Nut.
Indigenous. Often used as a hedge, in which case it is kept trimmed. [Ligon describes the Physic Nut as the most useful of the indigenous plants of Barbados, and "of a good height" (18 feet).] It is not common nowadays.

BALSAMINACEAE.

Impatiens spp. & vars. Balsam.
European, but probably originated in the East Indies. There are single and double varieties. A fairly common variety in Barbados is the Mexican Balsam (*I. sultani*) possessing cerise flowers.

MALVACEAE.

Hibiscus rosa-sinensis & vars. Common Hibiscus.
A very common ornamental shrub. Flowers—large and crimson. A double variety is also grown, and also a pendulous-flowered variety. Hedges of hibiscus are not very common to Barbados.

Hibiscus schizopetalus. Chinese Hibiscus.
Petals, lacerated.

Hibiscus mutabilis. Changeable Rose Hibiscus.
Not common. Flowers, large. In the morning the flowers are white; at mid-day, pale-red; and at night, purplish-red. Probable place of origin of Hibiscus—East Indies.

Althaea rosea & vars. Hollyhock.
Introduced from Europe. Grows fairly well in Barbados, especially the pink variety.

VIOLACEAE.

Viola odorata. Violet.
European. Cultivated chiefly in boxes, and grows remarkably well in Barbados.

Viola tricolor. Pansy.
European. Seldom thrives in Barbados.

PASSIFLORACEAE.

Passiflora laurifolia. Water Lemon.
Grown on fences. The fruits are edible.

Passiflora quadrangularis. Granadilla.
Passiflora is a South American and West Indian genus.

BEGONIACEAE.

Begonia spp. & vars. Begonia.
The commonest garden variety is the pink Begonia. Not indigenous to Barbados, but indigenous to other West Indian Islands, e.g., Jamaica, St. Domingo, Martinique, &c.

CACTACEAE.

Cereus spp. Cactus.
Several (at least three) climbing species of *Cereus* are cultivated in gardens in Barbados, and also one or two columnar species. Certain of them possess large, remarkably odorous flowers, which open at night. South American and West Indian.

Phyllocactus spp.
Globular Cactus. Occasionally grown in Barbados.

Pereskia aculeata. Barbados Gooseberry.
Possibly indigenous. A prickly climbing shrub, possessing true, expanded, green leaves. Fruit, an edible berry.

PUNICACEAE.

Punica granatum. Pomegranate.
Often grown in gardens as a shrub. A double variety (known as the Pomegranate rose) is also grown.

LYTHRACEAE.

Lagerstroemia indica vars. Queen of Flowers.
Shrubs possessing showy white, pink or mauve flowers. East Indies.

COMBRETACEAE.

Quisqualis indica. Quisqualis.
A common liane, possessing numerous clusters of flowers which attract many Sphingid moths in the evening. The flowers are long and tubular, with star-shaped, recurved corollae. Colour, white on opening, turning deep red towards evening. Place of origin. East Indies.

PLUMBAGINACEAE.

Plumbago capensis, Plumbago rosea, Plumbago zeylanica. Blue, Pink, and White Plumbago.
South African and Indian. Common flowering shrubs.

OLEACEAE.

Jasmium spp. Jasmine or Jessamine.
A common climber on fences. Place of origin, Arabia and East Indies.

APOCYNACEAE.

Allamanda carthartica. Allamanda, Yellow Bell.
A trailing shrub possessing large, funnel-shaped flowers, and milky latex. Fruits are not often produced.

Allamanda violacea. Pink Allamanda.
This may be a genus other than *Allamanda,* or at least another species of *Allamanda.* The fruit is commonly produced. It is a schizocarp consisting of two follicles placed in a straight line and pointed at their ends. Seeds, each with a parachute of hairs. *Allamanda* is a native of South America.

Tabernaemontana sp. Jasmine Bush.
A shrub possessing numerous white, odorous flowers of one inch diameter. Place of origin, East Indies.

Vinca rosea & vars. Periwinkle.
A woody herb possessing star-like, rose-coloured flowers. A variety (*alba*) has a white flower, and another (*?occellata*) white, with a red ring in the centre. *Vinca* is wild in many places in Barbados. It is a West Indian plant, but was probably introduced into Barbados by man.

ASCLEPIADACEAE.

Stephanotis floribunda. Stephanotis.
A liane. Place of origin, Madagascar. Fruit, a large fleshy follicle. Seeds, each furnished with a parachute of hairs.

Hoya curuosa. Wax Flower.
The flowers occur in umbels of a pink colour. Native of East Indies.

CONVOLVULACEAE.

Porana volubilis. Coralilla.
(Or probably more correctly Coronilla, from "corona"—a crown).
A favourite climber. Bears dense pannicles of small, white, odorous flowers. Flowering period, near Christmas. Place of origin, East Indies and Malay.

Argyreia speciosa. Cephalic Vine.
A climber possessing very large heart-shaped leaves, which are white beneath. Flowers, large and white. East Indies.

Ipomea bona-nox. Moon Flower.
A large night-blooming Convolvulus. A climber. Possesses heart-shaped leaves, and large odorous white flowers.

Ipomea palmata. Purple Ipomea.
A climber. Flowers, bell-shaped, 2 inches long, deep purplish-crimson colour. Leaves with five leaflets. Egyptian.

Ipomea rubro-coerula. Blue Ipomea or Morning Glory.
A climber. Possesses large, cobalt-blue, funnel-shaped flowers. Mexican.

Quamoclit vulgaris (=*Ipomea quamoclit*). Sweet William or Maiden's Tresses.
A delicate climber, with small palmatifid leaves and small flowers, one inch in length, of a rich crimson colour.

POLEMONIACEAE.

Phlox drummondii, vars. Phlox.
Introduced from North America or Europe. A favourite border plant. Grows well in Barbados.

BORAGINACEAE.

Heliotropium peruvianum. Heliotrope.
Cultivated (as in England) for its sweet-scented flowers.

Myosotis sp. Forget-me-not.
Introduced from Europe. Grows freely in Barbados.

VERBENACEAE.

Verbena spp. & vars. Verbena.
A prostrate creeping plant, with rose, mauve-coloured or white flowers. Introduced from Europe.

Petrea volubilis. Petrea.
A liane with long, pendulous racemes of blue flowers. The flower possesses a double calyx, the outer whorl of which is star-shaped and blue. The inner calyx is small, and encloses a tiny purplish corolla. The inner calyx and corolla drop off soon after the flower opens, but the outer calyx persists in the fruit. Flowers in January, April, and again in October. South American and West Indian.

Duranta plumieri. Duranta.
A prickly shrub possessing pendulous compound racemes of numerous lilac-coloured flowers. The numerous yellow fruits form a conspicuous part of the plant. South American and West Indian.

Holmskioldia sanguinea. Chinaman's Hat.
Possesses disc-shaped, persistent, scarlet calyces. Indian. Not common in Barbados.

Clerodendron siphonanthus. Chandelier Plant.
A shrubby herb with large flowers arranged in panicles. East Indies. Rare in Barbados.

LABIATAE.

Salvia splendens. Scarlet Salvia.
Small shrub. Flower, tubular, one inch long, with scarlet calyx and corolla, the latter dropping out easily. Brazilian.

Salvia coelestina. Blue Salvia.
A low herb. Flowers, small. Mexican.

Coleus spp. Variegated Coleus.
European.

SOLANACEAE.

Solanum spp.
Several species of climbing solanum are grown in Barbados. The flowers are usually arranged in pendulous racemes, and in certain cases have a sweet smell, e.g., *S. seaforthianum*—Lilac. West Indian.

Petunia violacea. Petunia.
Both single and double varieties of *Petunia* are grown in Barbados. South America.

Cestrum nocturnum. Lady-of-the-night.
A shrub which bears cymes of small, greenish-yellow flowers, which give out at night an overpowering sweet scent. West Indian.

Nicotiana tabacum. Tobacco plant.
Once cultivated in Barbados, but only to a very small extent nowadays. It is grown in gardens as an ornamental plant. South American.

Capsicum frutescens. Nigger Pepper.
Probably an indigenous plant. Fruits, red, elongated, small berries.

Capsicum baccatum. Bird Pepper.
Probably a hybrid derived from the above. Fruits, red, spherical, very small. Varieties of *C. baccatum* have larger fruits.

Capsicum annum. Bell, Bonny, or Bonnet Pepper.
Possibly introduced from Europe. Fruits, red, conical and large (two inches long).

SCROPHULARIACEAE.

Russelia juncea. Antigua Heath.
A much-branched, leafless shrub, which bears red tubular flowers. Mexican.

Antirrhinum majus. Snapdragon.
European. Grows well in gardens in Barbados, and is common.

BIGNONIACEAE.

Bignonia unguis-cati. Cat's Claw.
A slender climber which climbs by modified stems whose extremities are hooked. Flowers, large, yellow, funnel-shaped. Fruit, a flat capsule, 1½ feet long. Seeds, winged laterally. West Indian.

Bignonia magnifice. Purple Bignonia.
A vigorous climber.

ACANTHACEAE.

Thunbergia fragrans.
A climber possessing white flowers. Introduced from the East Indies, but grows wild in many parts of Barbados.

Thunbergia alata. Yellow Thunbergia.
Possesses large flowers.

Eranthemum spp. Justicia.
A shrub possessing variegated leaves and curved, purplish-crimson flowers. East Indian.

RUBIACEAE.

Portlandia grandiflora. Portlandia.
A shrub possessing large, tubular, white flowers which emit a powerful sweet scent. West Indian.

Ixora coccinea and other spp. Ixora.
Several varieties are grown in Barbados. The chief are the brick-red and the yellow-flowered *Ixoras.* They seldom fruit.

Gardenia spp & vars. Gardenia.
The double Gardenia and the single (Cape Jesamine) are cultivated occasionally.

Pentas carnea. Pentas.
A herbaceous plant possessing lilac flowers. The commonest is a variety possessing long-styled flowers, although occasionally a variety with short-styled flowers occurs in gardens.

COMPOSITAE.

Helianthus annuus. Sunflower.
Seeds brought from Britain. Grows fairly well in Barbados.

Zinnia spp. & vars. Red, Pink, Yellow Zinnia.
Mexican.

Coreopsis (=Calliopsis) spp. Yellow Coreopsis.
Tropics.

Cosmos spp.
Of various shades; the commonest is orange. Petals serrated.

Calendula spp. Marigold.

Chrysanthemum spp. & vars.

(C) GYMNOSPERMAE.

CYCADACEAE.

Cycas revoluta, Cycas circinata. False Sago Palm.
The larger (*C. circinata*) occasionally produces fruits, but not freely.

(D) PTERIDOPHYTA.

FILICINEAE (Leptosporangiatae).

Adiantum spp. Maiden-hair Fern.
A well-known species, which is said to have arisen locally is *A. farleyense,* possessing large crinkled leaflets.

Asplenium spp.

Gymnogramme chrysophylla. Golden Fern.
Introduced into Barbados from others of the West Indian Islands.

Gymnogramme pulchella. Silver Fern.
Indigenous and wild in Barbados.

CHAPTER XXII.

(5) THE FOOD PLANTS GROWN IN BARBADOS.

(OTHER THAN FRUIT TREES)

INCLUDING ALSO CERTAIN PLANTS OF ECONOMIC IMPORTANCE.

1. *Saccharum officinarum* (Gramineae) Sugar-cane.
   Probably introduced into Barbados in 1640 (or thereabouts), 15 years after the first British colonization of the Island. Ligon states that the first plants were obtained from Pernambuco. The original home of the cane is probably the South Pacific Islands. Sugar-cane is the staple crop of Barbados.

2. *Ipomea batatas* (Convólvulaceae) Sweet Potato.
   Possesses swollen roots. Cultivated chiefly for local consumption. Probably introduced in the early days, soon after the first settlement of the Island, from South America, its original home.

3. *Dioscorea alata* (Dioscoreaceae) Yam.
   Possesses true tubers. Stated by Ligon to have been brought from Africa by slaves. Place of origin, probably East Indies.

4. *Artocarpus incisa* (Moraceae) Breadfruit.
   A medium-sized evergreen tree with large shiny, pinnatifid leaves, grouped in bunches at the ends of the otherwise bare branches. The leaves have large, sheathing, deciduous stipules. Dioecious. Male flowers arranged in fleshy spikes; female in numerous, globular heads, from which develop the large multiple fruits. These are seedless and are used as a vegetable. The plant was introduced into the West Indies from the South Sea Islands by Captain Bligh in 1793, along with many other "choice and curious plants."

5. *Colocasia esculenta* (Araceae) Eddoe.
   Possesses fleshy corm-like rhizomes. Introduced from the East Indies into Barbados before 1750.

5a *Xanthosoma sagittifolium* (Araceae) Tannia Eddoe.
   Similar to the above, but producing larger rhizomes. Introduced along with the Eddoe.

6. *Zea mais.* (Gramineae) Indian Corn, Maize.
   Cultivated in Barbados from the date of settlement (1625) Original home, probably South America.

7. *Musa sapientum* (Musaceae) Banana.
   Not yet grown extensively in Barbados. Introduced soon after settlement. Place of origin, probably Tropical Asia. The plant is said to have been introduced from China into the Canary Islands before A.D. 1500.

8. *Musa paradisiaca* (Musaceae) Plantain.
One of the chief food plants of the slaves in early days. Still cultivated to some extent. Place of origin, Tropical Asia.

9. *Manihot utillisima* } (Euphorbiaceae) Bitter Cassava.
Manihot palmata. } Sweet Cassava.
Cultivated for starch which occurs in the swollen roots. Introduced into Barbados (probably from Brazil, their place of origin) at the time of settlement.

10. *Cucurbita pepo* (Cucurbitaceae) Pumpkin.
Introduced into the Island before 1750. Original home doubtful, probably Mediterranean region.

11. *Cucurbita pepo var. melopepo?* (Cucurbitaceae) Squash.
A small fruit, 3 inches long. Date of introduction and place of origin; as above.

12. *Cajanus indicus.* (Leguminoseae) Pigeon Pea, or Green Pea.
A shrub, 6 to 12 feet high. Introduced before 1750. Place of origin, East Indies.

13. *Dolichos lablab* (with varieties) (Leguminoseae) Bonavist.
A creeper. Cultivated in Barbados from the date of settlement. Place of origin, East Indies.

14. *Vigna catjang.* (Leguminoseae) Black-eyed Pea.
An annual, creeping plant, bearing long pods. Frequently used as a green dressing. Introduced probably at some recent date.

15. *Phaseolus lunatus* (Leguminoseae) Lima Bean, Sugar Bean.
A biennial creeper. Several varieties are cultivated for food and as green dressings. Probably West Indian, but not indigenous to Barbados.

16. *Arachus hypogaea* (Leguminoseae) Ground-Nut, Pea-Nut.
A small annual, trailing plant which buries its ripening pods in the earth. Grows well only in light soil. Brazilian.

17. *Cocos nucifera* (Palmae) Coconut Palm.
This is cultivated occasionally near the sea shore in different parts of the Island, but nowhere to any appreciable extent. It is doubtful whether the Coconut belongs to the aboriginal flora of Barbados, or of the West Indies. It is said to have been introduced into many of the West Indian Islands from the South American Tropics (its probable place of origin) by the Spaniards. In Barbados, the Coconut suffers much from insect pests (chiefly scale-insects).

18. *Hibiscus esculentus* (Malvaceae) Okro or Ochra.
An annual. Height up to six feet. Cultivated by peasants for the edible young fruits, which are cooked as vegetables. Introduced into Barbados before 1750, probably from the East Indies or Egypt.

19. *Maranta arundinacea* (Marantaceae) Arrowroot.
Introduced at some date before 1750, and cultivated to a limited extent chiefly on the bare slopes of the Scotland District Hills) for the starch contained in its rhizomes. Place of origin, probably Tropical America.

20. *Zingiber officinale* (Zingiberaceae) Ginger.
Cultivated similarly to Arrowroot. Introduced before 1750. Original home, probably India or Asia.

21. *Canna edulis* (Cannaceae) Tous-les-mois.
Occasionally cultivated in the Scotland District. Place of origin, India.

22. *Sorghum vulgare* (Gramineae) Guinea Corn.
Introduced from Mediterranean region. Occasionally cultivated by peasants, and also grown on sugar estates.

23. *Sorghum saccharatum* (Gramineae) Imphee.
Introduced from India. Cultivated as food for animals along with Guinea Corn.

24. *Aloe vera* (=*A. vulgaris* =*A. barbadensis*) (Liliaceae) Barbados Aloe.
Used medicinally, but not nowadays exported. Little cultivated at the present day. Occasionally found wild. Introduced at the date of settlement, probably from the Mediterranean region.

25. *Lycopersicum esculentum* (Solanaceae) Tomato.
This has long been cultivated on sugar estates and in kitchen gardens. Introduced from South America.

26. *Brassica juncea* (Cruciferae) Mustard.
Cultivated chiefly by peasants. Introduced from Europe.

FODDER GRASSES. (Gramineae)

27. *Andropogon pertusus* (=*Amphilophis intermedia var. acida. sp. nov.* Stapf) Sour Grass.
Origin very doubtful. Stapf (1916) suggests that it is a hybrid derived from an indigenous species (which he names *Amphilophis feracidula*) and an Australian or Indian species introduced into Barbados before 1830.

28. *Panicum maximum.* Guinea Grass.
First introduced accidentally from Jamaica, into which Colony the plant had been imported in 1744 from Guinea.

29. *Panicum muticum.* Para grass.
Not very much cultivated. Needs a very wet climate or wet soil.

ECONOMIC PLANT.

30. *Gossypium barbadense* (Malvaceae) Cotton, Sea Island Cotton.
Sir George Watts, in his monograph on *Gossypium,* suggests that this plant is a hybrid between *Gossypium vitifolium* (which is practically synonymous with the original Linnaean *G. barbadense*), an indigenous, perennial cotton, and *G. brasiliense*, a South American plant. *G. vitifolium* probably was the cotton cultivated in the Antillean Islands in the 18th and early 19th centuries. Ligon mentions cotton as one of the cultivated crops of Barbados in 1650, soon after the colonization of the Island by the British in 1625. This plant was probably also *G. vitifolium.* Occasionally, specimens of it are to be seen at the present day in Barbados growing near labourers' huts. The extensive cultivation of Sea Island Cotton in Southern U.S.A. during the 19th century caused West Indian growers to abandon the crop in favour of sugar. The failure of sugar-cane cultivation towards the end of the 19th century, and the falling off in supplies of American cotton, induced West Indian planters again to try cotton. In Barbados, the export of cotton in 1901–1902 was practically nil, but in 1907–1908 it was nearly one million pounds weight. In 1912–1913 the export had fallen off to less than half that amount, and during 1915–1916 it had dropped still further to just over one hundred thousand pounds weight. During the present season 1916-1917, most of the available land in Barbados is under sugar cane cultivation.

PART III.

CHAPTER XXIII.

THE ORIGIN OF THE FLORA OF BARBADOS.

In considering the origin of the flora of Barbados, one must first learn as much as possible about the past history of the Island, not only from accounts in books but also from the testimony of the rocks of which the Island is composed. When discussing the geological history of Barbados (Part I, Chapter IV), the conclusion was reached that the Island is a true oceanic Island, that is to say, it has never at any time since its latest emergence from the sea been geographically connected with other islands of the Antillean Chain, or with Trinidad or with the mainland. It follows therefore that any plants which now populate Barbados must have been carried across the sea from land areas more or less remote. Plants may be transmitted from one place to another across water barriers either by natural agencies, (such as ocean currents, winds, and birds), or by artificial means, that is, by the agency of man who either consciously or unconsciously carries, or causes to be carried, seeds or other parts of plants capable of development into mature individuals.

Let us consider first the mode of action of the *natural means* of plant dispersal. The efficiency of ocean currents, winds and birds, in bringing about the populating by plants of a newly-exposed land mass, has been urged by Darwin and other botanists. It has received direct demonstration in the case of the populating of Krakatau (an Island in the Malay Archipelago, lying between Sumatra and Java) by plants introduced from neighbouring Islands. A recently published account of the observations made by several botanists on the new flora of Krakatau will be found in a book mentioned in the Bibliography (No 24.) In 1883, the Island of Krakatau was partially destroyed by violent volcanic explosions. Every vestige of life was exterminated, and a fresh substratum, which the great heat of the volcanic activity had completely sterilised, was exposed. In 1906, a party of botanists who spent a few hours on Krakatau, collected 137 species of plants. They found the vegetation by this time so dense that it was only with great difficulty that they were able to penetrate beyond the coastal belt. Investigations proved undoubtedly that plant species of the new flora of Krakatau had been introduced into the island from the neighbouring islands, of which the nearest, (except Sebesi, a small island 12 miles distant) are Java and Sumatra, separated from Krakatau by a stretch of water of width about 25 miles. Further investigations yielded results which demonstrated to a striking degree the efficiency of ocean currents, winds and birds as natural means of plant dissemination. Important conclusions were also drawn as to the parts played by each of these agents in the final repopulating of Krakatau with plants.

There are many other examples on record of the methods whereby an isolated land area such as an oceanic island may become colonised by plants (and by animals also), and considerable knowledge of the process of geographical distribution of plants has been accumulated by naturalists. (See Bibliography, Nos. 26, 27, 29).

The general conclusions drawn from investigations on the relative efficiency of the three natural agents, ocean currents, winds and birds, responsible for the introduction of plants into oceanic islands, are, that ocean currents constitute the most important agent of plant dispersal, and birds the least important, and that wind occupies an intermediate position.

Let us now apply these results to the special case of the oceanic island of Barbados. The nearest land mass to Barbados is St. Vincent, which lies to the west, and 90 miles distant. Trinidad is some 150 miles to the south-south-east with Tobago (110 miles from Barbados) intervening. The mainland of South America is distant about 200 miles at its nearest point, but the land near the mouths of the Orinoco and in Guiana, due south of Barbados, lies between 300 and 600 miles away. To the north of Barbados, the semi-circular chain of the islands of the Lesser Antilles stretches for several hundreds of miles, but Barbados is not in the line of these islands but is situated rather to the east. It is important to picture accurately the geographic position of Barbados in order to estimate the efficiency of ocean currents as a natural agent in the process of populating the Island with plants. It is necessary next to consider what are the ocean currents that wash the shores of Barbados.

(1) OCEAN CURRENTS.

An inspection of a map showing the location of the various ocean currents which occur in different parts of the world, shows that Barbados lies in the path of a branch of the South Equatorial Current, which flows across the Atlantic from the West Coast of Africa, and is divided by the great projection of the South American Continent into two branches. The branch which travels in a north-westerly direction past the mouths of the Amazon, diverts the flow of water from this river into its own direction. The combined currents then subdivide off the coast of Guiana. One branch goes out eastward parallel to the Equator, and eventually swells into the Guinea current, while the other merges with the water of the River Orinoco, and flows into the Caribbean Sea.

In its passage into the Caribbean Sea, this branch sweeps past the islands of Trinidad and Tobago, and the most southerly islands of the Antillean Chain. The shores of Barbados are thus washed by a current that has previously visited many distant lands, and it is not unreasonable to suppose that this current may bring with it much debris, including woody seeds or fruits or pieces of drift timber, which might, under favourable circumstances, serve to introduce plants into the Island. Darwin showed how certain seeds or fruits could withstand immersion in water for a considerable period of time, and still be capable of germination. He made experiments on the relative powers of resistance of seeds or fruits of many kinds of plants, and showed how it would be possible for certain of them to withstand a long ocean journey, and thus to be quite capable of introducing the species into a country far distant from their places of origin. Sea-shore plants especially figure amongst plants dispersed by ocean currents.

The flora of the beaches of Barbados includes many indigenous plants which might easily have been brought originally to Barbados by the south-easterly ocean current described above. Most of the Barbados strand plants figure in the beach flora of Trinidad and South America. Moreover, they possess woody seeds or fruits which could resist sea-water for a considerable period of time.

Seaside Lavender, Goat's foot Ipomea, seaside Grape, Manchineel, Seaside Mahoe, Scarlet Cordia, and Horse Nicker afford examples of Barbados beach plants whose fruits or seeds could quite easily be disseminated by ocean currents. We are thus safe in concluding that these plants were introduced into Barbados in the first instance by this agent of plant dispersal.*

In considering the means whereby ocean currents carry the germs of plants from one place to another, the efficiency of drift timber must not be underestimated, for Darwin's work has shown that numerous seeds may be carried lodged in the soil occurring in the tangle of roots of torn-up trees. In this way inland plants (especially those growing on the banks of rivers) might be transmitted from one country to another through the agency of ocean currents.

In order fully to appreciate the importance of the processes discussed above, it may be interesting to name actual examples which have come under the observation of inhabitants of Barbados, and which indicate beyond doubt the significance of the south-easterly ocean current as a main factor in the colonization of the Island by plants.

The first example to be quoted is the frequent occurrence on the beaches of the eastern and south-eastern shores of Barbados of the fruits of a species of South American palm (*Manicaria saccifera,* Timite). These fruits go by the name of Sea-Coconuts. They are, however, seldom known to germinate on the shores of Barbados, and the palm is never found growing amongst the beach vegetation of the Island, although plentiful in Trinidad and the Guianas. This fact, nevertheless, is not contradictory to the view that Sea-Coconuts provide evidence of the importance of the south-easterly ocean current as an agent of plant dispersal, but rather it strengthens this conclusion by proving that the fruits of this particular palm must have come from abroad, since they could not simply have dropped from any known plant already growing in Barbados.

The second example is the record of the arrival on the southern beach of Barbados, some years ago, of a piece of drift timber carrying a living specimen of a South American alligator. The stuffed remains of this animal may still be seen displayed over a store in Roebuck Street in Bridgetown.

In all probability, much drift timber has arrived at different times on the shores of Barbados from South America, having been borne by the south-easterly ocean current, and many individuals and species of plants as well as animals must have been introduced into the Island in the past by this means.

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* See, also, the results of H. B. Guppy's recent researches, summarized in the Appendix.

(2) WINDS.

When considering the climatic factors which have been, and still are, influential in controlling the distribution of plants in Barbados, mention was made of the North-East Trade Wind which blows over the Island for the greater part of the year, and of the occasional south-easterly gales, which are experienced during the rainy season.

The North-East Trade Wind, in its passage over the North Atlantic Ocean, encounters no land between Africa and the West Indies, except the Canary Islands and the Cape Verde Islands. It is scarcely possible, therefore, that it can transport any living plant germ from Africa to the West Indies, a distance of over 2,000 miles. The south-easterly gales, on the other hand, originate in the northern regions of South America. These regions are not very remote from Barbados; they are little more than 250 miles away. The violence of these gales on occasions renders them capable of transporting light objects such as certain plant seeds, and their importance as an agent in the plant colonization must not be disregarded. Direct evidence of the ability of the south-easterly gales to introduce light objects into Barbados from land areas to the south is afforded by the not infrequent occurrence in Barbados of a South American moth (*Urania leilus*) which is only to be noticed immediately after a southerly gale has been blowing and before the Rain Bird (*Tyrannus rostratus*) has had time to bring about its quick extermination. Undoubtedly the south-easterly winds, by introducing in the first place spores of blue-green algae and nitrogen-fixing bacteria, were responsible for the preparation of the aboriginal soil of Barbados for its subsequent colonization by higher plants. Amongst the higher plants indigenous to Barbados, and represented in its present day flora, there are many species that possess seeds or fruits capable of being carried by wind.

(3) BIRDS.

Several kinds of migratory birds visit Barbados on their journeys from North America to the warmer regions of the southern continent. Many of these visitors alight at more than one of the Antillean Islands, their descent being especially frequent during squally weather, and when strong southerly gales are blowing.

Sportsmen of Barbados frequently find seeds of grasses and of certain Leguminous plants contained in the crops of birds shot in the coastal swamps. They also often notice pieces of earth adhering to the feet of these birds, and these pieces of earth may contain transported seeds.

A comparison of the flora of the Northern Islands of the Antilles with the indigenous flora of Barbados, indicates that there are certain plants common to both, but not common to Barbados and to South America. This suggests that the seeds or fruits of these plants were carried in the first instance, and are still being carried, by birds as they travel southwards from island to island. It is thus almost certain that many plants owe their presence in the numerous islands of the Caribbean area to dissemination by birds.

(4) MAN.

We come finally to a consideration of the effect on the flora of Barbados of man as an agent of plant dispersal. The great effect of man on the composition of the flora of Barbados is one of the most striking features of its present-day vegetation. By far the greater number of plants that occur in Barbados are exotic plants; plants whose introduction into the Island has been in some way or other due to man. The process of plant importation by human agency is still proceeding, and, as the regions in the Island occupied by indigenous plants decrease in size and in number, this aspect of the flora will become more and more conspicuous, until finally it will be difficult to find in Barbados any district of appreciable extent where indigenous plants grouped in natural plant community occur.

APPENDIX.

NOTES FROM "PLANTS, SEEDS AND CURRENTS IN THE WEST INDIES AND AZORES,—BEING THE RESULTS OF INVESTIGATIONS CARRIED OUT IN THOSE REGIONS BETWEEN 1906 AND 1914," BY H. B. GUPPY.

(Williams and Norgate, London, 1917).

In this recent contribution to knowledge of the mechanism of plant dispersal, the author describes the results of his researches on the transportation by ocean currents of seeds and fruits from the shores of West Africa to those of the South American continent; thence to the Caribbean Sea and the Gulf of Mexico, and finally from these Western regions to the shores of the Azores and of Europe.

CHAPTER I.

Guppy first deals with the beach-drift of the West Indian Islands (which is of fairly uniform character throughout the region), drawing distinction between local beach-drift, derived from the plants already growing within the boundaries of any one island, and foreign drift, derived from other islands across the sea. He then deals with his studies of the beach drift of the Turks Islands, (which are situated some 650 miles to the south-east of Florida, and which lie in the path of the Gulf Stream). He regards the Turks Islands drift as representing oceanic drift in transit between the western and the eastern sides of the North Atlantic Ocean.

CHAPTER II.

Next the author mentions examples of West Indian plants whose seeds or fruits are found washed up on the shores of the Azores and of Europe.

(It is interesting here to note the occurrence of the seeds of a common Barbadian and West Indian beach plant (*Guilandina bonducella*, Horse Nicker) amongst the beach drift of the Azores and of the British Isles and Northern Europe).

CHAPTER III.

In this chapter the author deals with the "drifting bottle" method of tracing the tracks of ocean currents, and of estimating the time taken by drifting bottles to complete particular voyages. He concludes that seed-drift in large amount could be carried across the South Atlantic Ocean from the West Coast of Africa to West Indian regions in a few months' time, provided these seeds could withstand a voyage of so long a duration.

CHAPTER IV.

The similarity of West Indian and West African sea-shore floras is next noted. The author states that, of the plant species found in both the tropics of the Old and the New World, 90 per cent. possess seeds or fruits which could withstand the voyage across the South Atlantic. Of the species which are confined to the tropics of the New World, less than 24 per cent., however, could

undergo the journey. These figures favour the ocean current hypothesis as the explanation of the similarity between the tropical beach floras of the Old and the New World.

[In Guppy's lists, the following familiar seashore plants of Barbados are mentioned as being common to both the Old and the New Worlds:—

Canavalia obtusifolia. (Sword Bean)
Cenchrus echinatus. (Burr Grass)
Guilandina bonducella. (Horse Nicker)
Heliotropium curassavicum. (Wild Lavender)
Ipomaea biloba (=*pes-caprae*). (Goats-foot Ipomaea)
Laguncularia racemosa. (a Mangrove swamp plant)
Portulaca oleracea. (Purslane)
Rhizophora mangle. (Mangrove)
Sesuvium portulacastrum. (Seaside Samphire)
Thespesia populnea. (Seaside Mahoe)

The following (amongst others) are stated, however, to be confined to the New World, and widely distributed throughout the West Indies.

Coccoloba uvifera. (Sea Grape)
Euphorbia buxifolia. (Seaside Spurge)
Hippomane mancinella. (Manchineel)
Tournefortia gnaphalodes. (Seaside Lavender)
all common Barbadian sea-shore plants.

CHAPTER V.

This is an account of certain facts concerning the Mangrove tree (*Rhizophora mangle*).

CHAPTER VI & CHAPTER VII.

Herein the author considers in detail the characteristics of several Turks Islands drift-plants from the standpoint of distribution.

[The following well-known plants, all of which occur in the Barbados flora, each receive individual consideration.

Spondias lutea. (Hog Plum)
Hippomane mancinella. (Manchineel)
Guilandina bonducella. (Horse Nicker)
Hymenaea courbaril. (West Indian Locust)
Mammea americana. (Mammee Apple)
Crescentia cujete. (Calabash)
Cassia fistula and *grandis;* and *Calophyllum calaba.* (Galba)]

CHAPTERS VIII, IX & X.

Other West Indian littoral plants are described in detail, also from the standpoint of distribution.

[They include the following plants common also in Barbados:—
Acacia farnesiana. (Sweet Briar)
Anacardium occidentale. (Cashew)
Canavalia obtusifolia. (Sword Bean)
Chrysobalanus icaco. (Fat Pork or Coco Plum)
Coccoloba uvifera. (Sea-grape)
Ipomaea biloba (=*pes caprae*). (Goat's-foot Ipomaea)
Swietenia mahagoni. (Mahogany)
Thespesia populnea. (Seaside Mahoe); and
Tournefortia gnaphalodes. (Seaside Lavender)
These are also individually described at length.]

CHAPTER XI.

The characters and geological structure of the Turks Islands are next outlined, and the conclusion is reached that they (like Barbados) are "oceanic" islands, and are formed on a basis of coral reefs.

CHAPTER XII.

The author next discusses the flora of the Turks Islands, which, he states, consists of scrub plants and sea-shore plants.

The scrub flora includes common West Indian plants, but it also includes plants which are restricted to the Bahamas as a whole.

[A similarity between the Turks Islands sea-shore flora and that of the beaches of Barbados is very noticeable from Guppy's account, but the scrub vegetation, although it includes such common Barbados rocky-land plants as *Lantana involucrata* (White Sage), *Phyllanthus epiphyllanthus* (Sickle-leaved *Spurge*), species of *Croton* and of *Pluchea,* is chiefly of a distinctive Bahamian type.]

Two-thirds of the Turks Islands littoral plants have been brought there by currents from the Antillean Islands, and, in all probability, originally came from the Old World. The remaining one-third of the littoral plants confined to the New World were doubtless introduced by birds, man, or by drifting logs. Birds were probably the agents responsible for the introduction of the scrub plants of Bahamian and Southern U.S.A. type.

CHAPTERS XIII, XIV, XV & XVI—

are concerned with the author's conclusions and views regarding the evolution and distribution of plant-forms over the earth's surface.

CHAPTERS XVII, XVIII & XIX—

deal with the geography and botany of the Azores. The Azorean flora includes woodland plants of Canarian and Madeiran resemblances, upland-moor plants of European relationships, and sea-shore plants, which show some affinities with the littoral floras of the American side of the Atlantic. The plants of the woods were probably introduced by birds (such as pigeons); those of the upland-moors by the medium of mud adhering to the feet of birds, or to their plumage; and the sea-shore plants by means of drifting logs chiefly. The Azorean coast is almost devoid of sea-beaches, being in the main rocky, hence its littoral flora is scanty.

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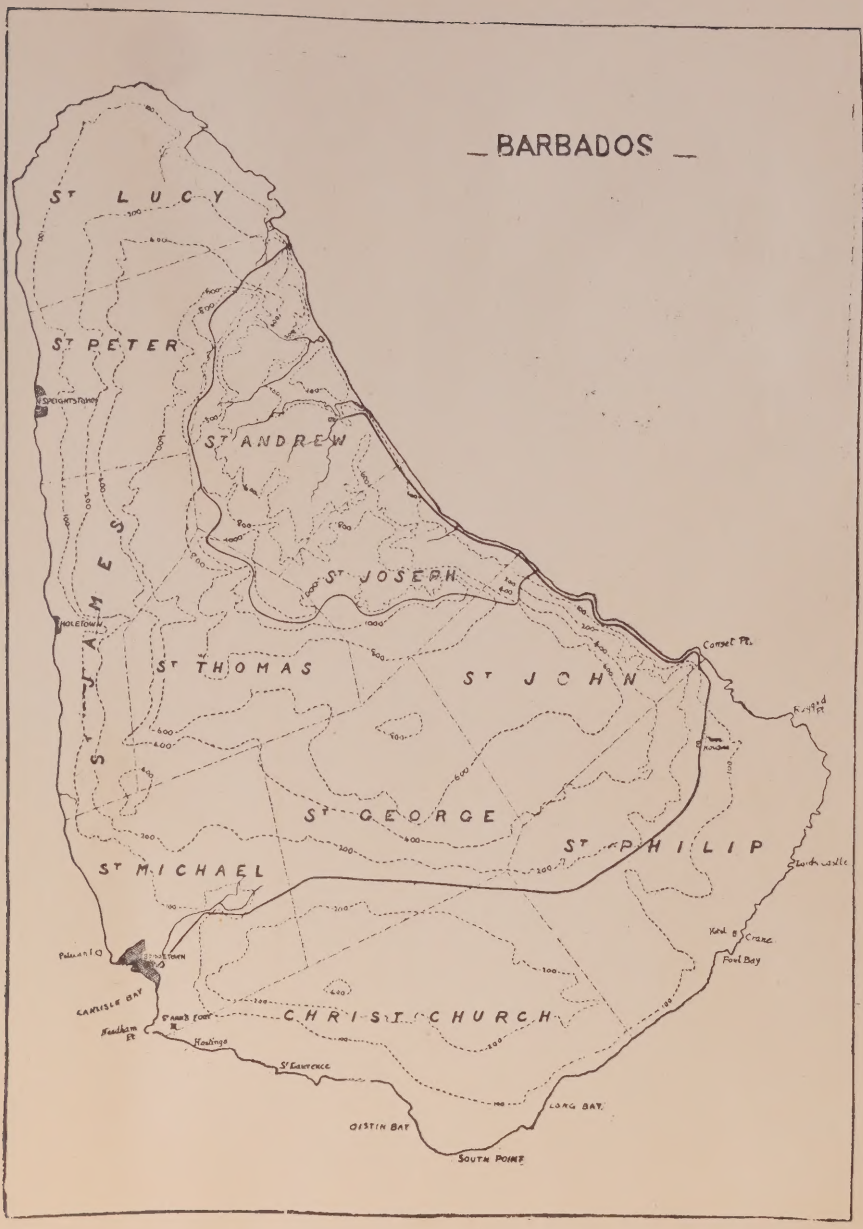
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